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THE INSECT PESTS OF COTTON IN TROPICAL AFRICA

by E. O. PEARSON

Director, Commonwealth Institute of Entomology, formerly Senior Entomologist, Empire Cotton Growing Corporation

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The main section of the book consists of an account of each of the more important pests, dealing with the taxonomy and distribution, appearance of the different stages, life-history and seasonal activity, nature of the damage inflicted on cotton, alternative host plants, natural enemies, factors affecting prevalence, and control. In the case of species or groups that are not confined to tropical Africa, relevant matter available from research on them elsewhere is included.

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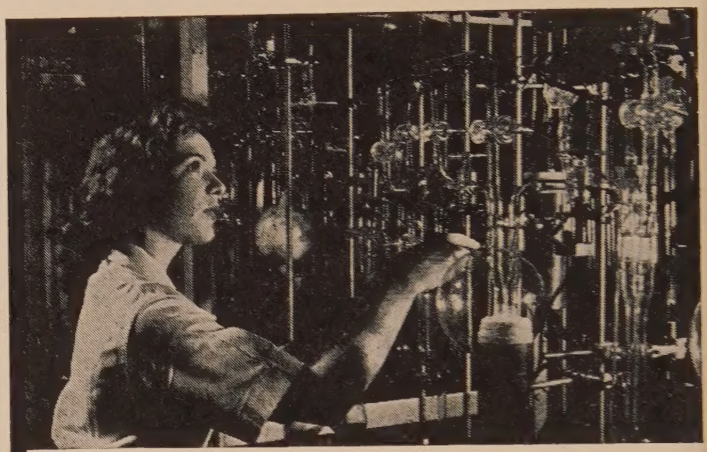

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Stroyan (H. L. G.). **Identification of aphids living on** *Citrus*.—*FAO Plant Prot. Bull.* **9** no. 4 pp. 45–65, 13 figs., 15 refs. Rome, 1961.

The identification of aphids found on *Citrus* has become important in the Mediterranean basin in connection with studies on the tristeza virus disease there [*cf. R.A.E.*, A **44** 332; **46** 206, 506]. The author gives information on the collection, preservation and preparation of aphid material from *Citrus*, a field key to the alate and apterous viviparae of seven widely distributed species that are common on the crop in various parts of the world, illustrations of their diagnostically important structures, and notes on the morphology, importance, synonymy and in some cases distribution of the individual species, with biometric data for single specimens. The species concerned are *Macrosiphum euphorbiae* (Thos.), *Myzus persicae* (Sulz.), *Aphis gossypii* Glov., *A. spiraecola* Patch, *A. craccivora* Koch, *Toxoptera aurantii* (Boy.) and *T. citricidus* (Kirk.). *T. citricidus* is a fairly efficient, and *A. gossypii* an inefficient, vector of the tristeza virus [*cf.* **44** 332]; the former does not occur in the Mediterranean area. A note on other aphids recorded on *Citrus* is appended.

Dormal (S.), Martens (P. H.), Decleire (M.) & de Faestraets (L.). **Étude de la persistance de résidus d'insecticides dans divers légumes frais, blanchis et stérilisés.**—*Bull. Inst. agron. Gembloux* **27** no. 2 pp. 137–147, 4 refs. Gembloux, 1959. (With a summary in English.)

The residues left on spinach, peas and beans [*Phaseolus*] by sprays prepared from proprietary emulsion concentrates of mevinphos (Phosdrin), trichlorphon (Dipterex), parathion, Isochlorthion (O,O-dimethyl O-4-chloro-3-nitrophenyl phosphorothioate) and DDT and applied at intervals of 0–14 days before harvest and the extent to which they are removed by blanching and canning processes were investigated in Belgium in 1958. The residues were heaviest on spinach and light on beans; on peas, only mevinphos and trichlorphon left any residues, and these were very light. These two insecticides were the least persistent, and their residues disappeared within 4–6 and 6–12 days, respectively; residues of parathion and Isochlorthion persisted for 12–20 days, and those of DDT for several weeks. The percentage of the residues destroyed during blanching and (in brackets) sterilisation were 40–85 (70–95) for parathion and Isochlorthion and 20–40 (40–60) for DDT; blanching and sterilisation almost completely destroyed the residues of mevinphos and trichlorphon. It is concluded that vegetables treated with these insecticides will bear negligible residues provided that the interval required by Belgian regulations has elapsed between the last application and harvest.

Brown (W. B.). **Fumigation with methyl bromide under gas-proof sheets.**—*Pest Infest. Res. Bull.* no. 1 (2nd edn.), vi + 44 pp., 8 pls., 12 figs., 25 refs. London, H.M.S.O., 1959.

This bulletin contains three main sections, concerned, respectively, with methyl bromide as a fumigant, the technique of fumigating stacked stored products with it under gas-proof sheets for the control of pests, and methods for determining the effectiveness of the fumigation.

Parkin (E. A.). **The susceptibility of stored-product insects to contact insecticides.**—*Chem. & Ind.* 1960 pp. 108–111, 15 refs. London, 1960.

The author reviews differences in the susceptibility of different species of stored-products insects to insecticides recorded in the literature [*cf. R.A.E.*,

A **41** 443; **46** 171] and reports further laboratory investigations. At 25°C. [77°F.] and 70 per cent. relative humidity, a dust of 0·5 per cent. γ BHC did not give satisfactory knockdown or kill of adults of *Tribolium castaneum* (Hbst.) at 20 parts γ BHC per million in wheat, but 5 p.p.m. was sufficient to suppress reproduction, and this was found in a subsequent test to be due to toxicity to the larvae in the eggs. A similar but less striking effect was observed with the eggs of *Oryzaephilus surinamensis* (L.). A malathion dust used similarly showed varying toxicity to eight species of Coleoptera. *O. surinamensis*, which is resistant to γ BHC, was extremely susceptible to it, and *T. castaneum* more susceptible to malathion than to γ BHC, but *Rhyzopertha dominica* (F.) was more susceptible to γ BHC. *Ptinus tectus* Boield. was very resistant to malathion.

Breeding from the survivors of each generation of adults of *T. confusum* Duv. exposed to dosages of methyl formate vapour in air that killed 65–90 per cent. of the insects trebled the LD50 in 35 generations, and selection by pyrethrum pressure of a strain of *Sitophilus* (*Calandra*) *granarius* (L.) that was already resistant to pyrethrum increased the original resistance by about 6 times in 18 generations. When adults of *S.* (*C.*) *oryzae* (L.) were exposed on wheat treated with 0·5 per cent. γ BHC dust at different rates, there was a small rise in resistance in four generations, but not more than could be ascribed to vigour tolerance.

It is concluded that the differences in susceptibility of different species to contact insecticides are too great for generalised statements of toxicity, that more work needs to be carried out, that laboratory assessments of relative resistance should be judged against the natural differences in susceptibility of field strains, and that strains of stored-products insects can be selected to show small increases in resistance to particular insecticides.

Green (A. A.) & Kane (J.). **A comparison of lindane, DDT and malathion for the protection of bagged groundnuts from infestation by** *Tribolium castaneum* **(Hbst.).**—*Trop. Sci.* **1** (1959) no. 4 pp. 290–295, 9 refs. London, 1960.

The following is virtually the authors' summary. A laboratory comparison was made of γ BHC (lindane), DDT and malathion water-dispersible powders for effectiveness in protecting clean, bagged groundnuts from infestation by *Tribolium castaneum* (Hbst.) during a storage period of six months. Miniature jute sacks filled with groundnuts were sprayed externally with the insecticides, and single treatments, applied at the beginning of the storage period, were compared with repeated monthly applications. Conditions of cross-infestation were simulated by adding beetles at fortnightly intervals.

The rate of development of the infestations was assessed by monthly sampling; and final infestations were measured by sieving all the groundnuts. All treatments gave some control, the repeated monthly applications being more effective than single applications. The most effective treatments were the monthly doses of malathion at 40 and 80 mg. per sq. ft.

Davey (P. M.), Hall (D. W.), Coveney (P. L. K.), Raymond (W. D.) & Squires (J. A.). **The effect of insect infestation on the quality of decorticated groundnuts with special reference to storage at high and low humidities.**—*Trop. Sci.* **1** (1959) no. 4 pp. 296–307, 3 refs. London, 1960.

Further laboratory experiments are described on the effect of infestation by *Tribolium castaneum* (Hbst.), *Caryedon gonagra* (F.) and *Trogoderma*

granarium Everts on the quality of decorticated stored groundnuts [*cf. R.A.E.*, A **45** 121]. The following is based on the authors' conclusions. Infestation by these insects causes considerable loss in weight and deterioration in the quality of the oil of groundnuts stored at the optimum conditions for development, which are 30°C. [86°F.] and 70 per cent. relative humidity. The free fatty acid content of kernels previously infested by these insects is not affected by storing at a higher relative humidity of 75 per cent., provided that mould does not develop, or at a lower humidity of 48 per cent. which, in any event, does not affect the rate of development of the insects. Therefore, from a practical point of view, the quality of West African groundnuts cannot be improved by storing at low relative humidities.

Heseltine (H. K.) & Royce (A.). **A concentration-time product indicator for fumigations.**—*Pest Technol.* **2** no. 5 pp. 88–92, 5 refs. London, 1960.

The effectiveness of fumigation against arthropod pests in stored products is related to the integrated product of the concentration of gas and the time of exposure [*cf. R.A.E.*, A **30** 30]. The gas concentration is usually ascertained by withdrawing samples of air at intervals through fine-bore tubing, which is undertaken by specialists. The authors describe a simpler method, involving the use of small gas-permeable plastic sachets containing a suitable absorbent for the gas being used and, if possible, a colour indicator, and give examples of the use of such sachets with ethylene oxide and methyl bromide.

Dyte (C. E.). **Preliminary tests of an insecticidal lacquer containing malathion.**—*Pest Technol.* **2** no. 5 pp. 98–99, 1 graph, 4 refs. London, 1960.

The results are given of tests in which a lacquer containing 10 per cent. by weight of malathion proved toxic to several species of Coleoptera that infest stored products when they were confined on surfaces treated with it. They included *Trogoderma granarium* Everts, which is not readily controlled by insecticides, and, in a comparative test, the malathion lacquer gave 50 per cent. kill of larvae in 450 hours, as compared with 600 hours for one containing 10 per cent. dieldrin. The effective life of the malathion lacquer was about a year.

Godavaribai (S.), Krishnamurthy (K.) & Majumder (S. K.). **Studies on malathion for stored product insect control.**—*Publ. Hlth & Sanit.* **2** no. 2 (in *Pest Technol.* **2** no. 7) pp. 12–15, 7 refs. London, 1960.

Since malathion seemed promising for the control of pests of stored grain, its value for the protection of flour from *Tribolium castaneum* (Hbst.) was tested in India. Malathion was first dissolved in carbon tetrachloride, and this was mixed with wheat flour and the solvent evaporated, to provide a means of incorporating the insecticide in the experimental flour. In a preliminary test of persistence, this was mixed with flour to provide concentrations of 8, 16 and 32 parts malathion per million, and the flour was stored in jute twill sacklets at 24–28°C. [75·2–82·4°F.] and 68–80 per cent. relative humidity and sampled at intervals. The amounts of malathion remaining were 2, 5·6 and 12·8 p.p.m. after eight weeks and 0·9, 2·7 and 7·3 p.p.m. after 12, as compared with a remainder of 1·2 mg. per sq. ft.

after eight weeks on porcelain tiles treated with malathion at 40 mg. per sq. ft. in carbon-tetrachloride solution and almost complete recovery from wheat flour stored in stoppered bottles.

In the tests with insects, adults of *T. castaneum* were starved for 24 hours and added to tubes containing flour treated with malathion at 8, 16 and 32 p.p.m. The tubes were kept at 28°C. and 68 per cent. relative humidity for 2–48 hours or two months; no mortality occurred for the first 24 hours, but there was 10, 20 and 27 per cent. mortality, respectively, after 48 hours, and 31, 56 and 84 per cent. after two months. The survivors after all exposures were transferred to untreated flour and kept for two months, after which it was found that exposure to malathion for two months prevented any breeding, whereas the shorter exposures had no such effect.

In further tests, the flour treated with malathion at the three rates was kept for 1 or 3 months in twill sacklets and the beetles were then added to it and left for two months. The mortality percentages were 12 and 4, respectively, for 8 p.p.m. malathion, 22 and 4 for 16 p.p.m. and 50 and 22 for 32 p.p.m., and reproduction occurred only in the flour treated with malathion at the lowest rate. Malathion caused off-odours in dough and unleavened bread prepared from flour containing 16 and 32 p.p.m., respectively.

Das (G. M.). **Occurrence of red spider in relation to cultural practices in north-east India.**—*Two and a Bud* **6** no. 4 pp. 3–10, 6 refs. Cinnamara, 1959.

The finding that *Oligonychus coffeae* (Nietn.) is present on the leaves of tea throughout the winter in north-eastern India [*R.A.E.*, A **47** 369] has intensified the problem of its control. The population that persists after plucking is reduced considerably by pruning and still further by cleaning-out operations, but can be eradicated completely only by defoliation. This can be done on healthy bushes, but is unsafe on weak bushes and those under five years old. Infestation is greater on dust-covered bushes near main roads, on bushes growing without shade and on those on poorly drained soil.

Sen (A. R.). **Pest and disease surveys.**—*Two and a Bud* **6** no. 4 pp. 16–22. Cinnamara, 1959.

A preliminary survey of pests and diseases of tea was undertaken in certain districts in north-eastern India in 1958 and extended in 1959. The methods adopted are described, and the results are summarised. The principal arthropod pests concerned were *Oligonychus coffeae* (Nietn.) and *Buzura* (*Biston*) *suppressaria* (Gn.), and data on the prevalence of these and other species are presented.

Mukerjea (T. D.). **New pesticides.**—*Two and a Bud* **6** no. 4 pp. 23–31. Cinnamara, 1959.

This is a review of the results of tests in north-eastern India in 1959 on the effectiveness of newly developed compounds against pests and diseases of tea. In field trials of sprays, Tedion and Kelthane both proved effective against the red spider [*Oligonychus coffeae* (Nietn.)], and endrin gave excellent control of the looper caterpillar [*Buzura suppressaria* (Gn.)] and was better than DDT.

Judenko (E.). **Further small-scale field experiments on the chemical control of attack by shot-hole borer** (*Xyleborus fornicatus* **Eich.**) **on tea in plucking.**—*Tea Quart.* **31** pt. 1 pp. 19–25, 3 refs. Talawakele, 1960.

The following is based on the author's summary and conclusions. The results are reported of a further 16 small-scale field tests on the chemical control of *Xyleborus fornicatus* Eichh. on tea in Ceylon [*cf. R.A.E.*, A **48** 534]. Only the lower parts of the bushes were sprayed, up to a height that depended on the height of the bush and was never more than 2 ft. Chlordane was markedly inferior to dieldrin when compared at dosages equal in cost. The minimum effective dosage of dieldrin was 1·1 lb. in about 100 gal. water per acre; this gave results roughly comparable with those from over 10 lb. dieldrin in about 200 gal. water per acre when applied on dry days. If the woody parts of the bushes were already wet when the spray was applied, the minimum effective dosage was 8 lb. per acre. Rain after spraying, but on the same day, seemed to have a slightly detrimental effect on the results. No practical recommendations for the use of dieldrin can yet be made.

Manickavasagar (P.) & Miyashita (K.). **The status of the paddy stem borer,** *Schoenobius incertulas* **Walk., in south east Asia.**—*Trop. Agriculturist* **115** no. 2 pp. 69–84, 6 figs., 27 refs. [Colombo] 1959.

This is a review of the literature on the distribution, life-cycle, restricted food-plant range, insect parasites, injuriousness and control of *Schoenobius incertulas* (Wlk.), a pest of rice, in the countries of south-eastern Asia.

Fernando (H. E.). **Studies of** *Empoasca devastans* **Dist. (fam. Jassidae, ord. Hemiptera), a new pest of cacao causing defoliation, and its control.**— *Trop. Agriculturist* **115** no. 2 pp. 121–144, 15 figs., 12 refs. [Colombo] 1959.

In June 1956, malformation, discoloration and premature shedding of the young leaves of cacao was observed in the Dumbara Valley, in Ceylon. Nymphs of *Empoasca devastans* Dist. and *Scirtothrips dorsalis* Hood were found on affected leaves, and investigations showed that the former were responsible for the condition. The symptoms are described, and the results are given of a study of the effects of feeding by the Cicadellid and of its control. The following is based on the author's summary of the results.

E. devastans feeds on the vascular bundles of the leaves, and, when feeding is restricted to a particular area of leaf, the damage is similarly restricted, suggesting that no systemic toxin is injected during feeding. Histological studies of leaves showed that *E. devastans* is predominantly a phloem feeder and does not attack the mesophyll. Stylet sheaths were not observed in the feeding tracks, but a material that stains deeply in safranine and plugs phloem cells was recognised in infested leaves. This material is mainly of plant origin, since it develops after feeding by the Cicadellid and phloem cells seem to disintegrate to form it. Chemical analyses showed that infested cacao leaves have an increased sugar content and a decreased nitrogen content. Of several insecticides tested, DDT in emulsion sprays at high or low volume and a 5 per cent. dust gave the best results and afforded complete control of *E. devastans* and also of *S. dorsalis* for at least a week.

Swirski (E.) & Amitai (S.). **Contribution to the biology of the *Citrus* rust mite (*Phyllocoptruta oleivora* Ashm.). C. Oviposition and longevity of males and females.**—*Ktavim* (Engl. edn.) **9** no. 3–4 pp. 281–285, 5 graphs, 5 refs. Rehovot, 1959.

Since little is known of the mode of reproduction of *Phyllocoptruta oleivora* (Ashm.), investigations were carried out in Israel in which the mite was reared on lemons. It was found that only males developed from the eggs of unfertilised females, whereas both sexes were produced by fertilised ones, the percentage of females in the progeny being 57·1. At 26°C. [78·8°F.], females lived for up to 17 days and males for up to 13, 50 per cent. mortality occurring in 8–9 and 5–6 days, respectively. Autumn females lived for up to 17 days and winter ones for up to 41, and 50 per cent. mortality occurred in about 9 and 29 days, respectively. At 26°C., 77 fertilised females laid a total of 718 eggs, half of them in the first quarter of their lives; 41 females reared in September–October laid 409 eggs in 13 days, and 23 reared between February and the beginning of April laid 175 in 41 days. In all, the average number of eggs per females was 7·6–10·7, the greatest number (26) being laid in September by a female that survived for 20 days. The length of the preoviposition period varied. Some females in summer oviposited on the day of the last moult, and some in winter not for 18 days.

Moore (I.). **A method for artificially culturing the olive fly (*Dacus oleae* Gmel.) under aseptic conditions.**—*Ktavim* (Engl. edn.) **9** no. 3–4 pp. 295–296, 5 refs. Rehovot, 1959.

The production of parasites for the biological control of *Dacus oleae* (Gmel.) on olive in Israel depends on the availability of hosts throughout the year. A method of rearing the Trypetid on a synthetic diet is described. The oviposition substrate consists of paraffin hemispheres covering moist cotton-wool. The eggs are recovered from the inner surfaces of these, washed, and transferred to the larval medium, which contains casein and yeast, directions for preparing which are given. At 23°C. [73·4°F.], development from egg to adult lasted 38 days, as compared with about 28 in olives, indicating that the medium requires improvement.

I Kongres stručnjaka za zaštitu bilja, 29-X–1-XI-1957. II. Entomološka sekcija. [First Congress of specialists in plant protection, 29-X—1-XI-1957. II. Entomological section.]—*Plant Prot.* no. 49–50, 207 [+4] pp., 8 pls., text illus., refs. Belgrade, 1958.

The following are abstracts of papers read in this section of a congress held in Yugoslavia in 1957 [*cf.* also *R.A.E.*, A **49** 335].

Kovačević (Ž.). **Utjecaj klime i vrste hrane na dinamiku populacije nekih štetnika** [The effect of climate and quality of food on the population dynamics of certain pests], pp. 5–8 (with a summary in German). The most important pests of fruit and forest trees in Yugoslavia are *Lymantria dispar* (L.), *Malacosoma neustria* (L.), *Euproctis chrysorrhoea* (L.) and *Hyphantria cunea* (Dru.); the effect of climate and type of food on them is briefly discussed.

Vasić (K.). **Uporedna analiza toka gradacije gubara 1946–1950 i 1953–1957 godine** [Comparative analysis of the courses of the outbreaks of the gipsy moth in the years 1946–50 and 1953–57], pp. 9–22, 6 graphs,

11 refs. (with a summary in English). The author compares the two outbreaks of *Lymantria dispar* (L.) that occurred in forest regions of Yugoslavia in 1946–50 and 1956–57, particularly with respect to climatic conditions, and shows that they both occurred during periods of slight, though constant, decrease in temperature; the biological potential of the moth has been shown to be greatest at temperatures below 20°C. [68°F.].

Zečević (D.). **Dnevna potrošnja hrane gusenica gubara na hrastu i** *Pyracantha coccinea* [Daily food consumption of gipsy-moth larvae on oak and *P. coccinea*], pp. 23–33, 2 graphs, 5 refs. (with a summary in English). The daily amounts of food consumed and the small differences in development that occurred when larvae of *Lymantria dispar* (L.) were reared in the laboratory on the leaves of oak (*Quercus robur*) and *Pyracantha coccinea*, an evergreen used for winter rearing [*cf.* **45** 459], are recorded. Oak proved the better food. It is suggested that the area of leaf consumed per larva might be used in forecasts of probable damage in oak forests.

Janković (L.). **Prilog poznavanju biljki hraniteljki gubara u prirodi u toku poslednje gradacije (1953–1957 god.)** [A contribution to knowledge of the food-plants of the gipsy moth in nature during the course of the last outbreak (1953–57)], pp. 35–39, 14 refs. (with a summary in English). Lists based on observations during the outbreak of *Lymantria dispar* (L.) in Yugoslavia in 1953–57 are given of 14 trees that provided optimum food for the larvae, 23 others on which development was completed, and 44 miscellaneous plants that were also attacked. The first group comprised mainly forest trees, principally oaks (*Quercus* spp.).

Maksimović (M.). **Prilog istraživanju brojnosti gubara metodom klopke** [Contribution to the investigation of the numerousness of the gipsy moth by means of traps], pp. 41–47, 1 fig., 8 refs. (with a summary in English). Work was begun in Yugoslavia in 1952 on the preparation and use of extracts containing the sex attractants of females of *Lymantria dispar* (L.) for determination of the numbers of the moth in forests. It was found that increase in the numbers of males attracted to traps baited with the extract coincided with increases in egg populations. An increase from 24 to 67 males per trap indicated an increase in the average numbers of egg-masses per ha. from 18·6 to 27·6, which is the level at which an outbreak becomes imminent.

Grozdanović-Simić (J.). **Ponašanje gubara u tretiranoj šumi** [The behaviour of the gipsy moth in treated forests], pp. 49–54, 3 refs. (with a summary in English). Observations were made in 1957 on plots in the forest district of Rogot, near Belgrade, on the population of *Lymantria dispar* (L.) on areas that had been treated with DDT sprays and fogs in 1955. It was found that egg-masses were unevenly distributed, sprayed areas showing the fewest. There was heavy mortality of eggs and larvae in spring. apparently as a result of climatic influences.

Balarin (I.). **Utjecaj nekih insekticida na jaja gubara** [The effect of certain insecticides on the eggs of the gipsy moth], pp. 55–59 (with a summary in German). In tests of insecticide for use against the eggs of *Lymantria dispar* (L.) in winter, good results were given by several proprietary preparations for use on fruit trees and by sprays of DDT, γ BHC and parathion, which also killed considerable proportions of the hatched larvae, and sprays of two systemic insecticides, demeton (Systox) and methyl-demeton (Metasystox), of which the former was more effective against the eggs and the latter against the larvae.

Živojinović (S.). **Značaj istraživačkog rada za suzbijanje gubara** [The importance of research on gipsy moth control], pp. 61–66 (with a summary

in English). Since Yugoslavia affords optimum climatic conditions for the development of *Lymantria dispar* (L.), outbreaks in forests and orchards are of regular occurrence. Much effort is devoted to control, but the work is usually begun too late. Further study of the ecology of the moth is desirable if losses are to be prevented, and suggestions for increased scientific work are made.

Peyrek (B.). *Otiorrhynchus* (*Dodecastichus*) *mastix* **štetnik jagodnih nasada na Slov. primorju** [*O.* (*D.*) *mastix*, a pest of strawberry plantings on the Slovenian coast], pp. 67–72, 1 pl., 1 ref. (with a summary in English). *Otiorhynchus mastix* (Ol.), which normally feeds on wild plants, caused severe damage to strawberry on the coast of Yugoslavia from Karst to the gulf of Boka-Kotorska in 1954–57. The fertilised females oviposit between 20th July and 10th August, and the larvae feed on the roots in autumn, winter and spring and pupate in April. The adults appear in early May and pair in July. Tests of insecticides against the larvae gave poor results, but dieldrin in an emulsion spray appeared promising against the adult weevils.

Vladislav (V.). **Kruškin trips** (*Taeniothrips inconsequens* **Uzel), njegova pojava, raširenost i štetnost na području Bosne i Hercegovine** [The pear thrips (*T. inconsequens*), its appearance, distribution and harmfulness in the territory of Bosnia and Herzegovina], pp. 73–80, 5 refs. (with a summary in English). *Taeniothrips inconsequens* (Uzel) caused serious damage to fruit trees in the Mostar district of Herzegovina in 1946, when expanding leaves and flower buds were destroyed, and in 1947–57, when the leaves were chiefly attacked. Cherry and early plum were mainly affected. The adult thrips appear in the second half of February, when the buds are swelling, and the larvae are present from early March to mid-April. Infestation in other parts of the country is less severe, and development somewhat later, because of cooler conditions.

Živanović (V.). **Najnovija pojava šljivine štitaste vaši u N.R.Srbiji** [A new outbreak of *Eulecanium corni* in Serbia], pp. 81–86 (with a summary in English). Outbreaks of *Eulecanium corni* (Bch.) on plum occurred in Yugoslavia in 1919–30, 1933–35 and 1942–46. A further outbreak began in 1953–54 and is still in progress, mainly in southern, south-eastern and western Serbia.

Tomić (D.). **Prilog poznavanju ciklusa razvića malog topolinog staklokrilca** [A contribution to knowledge of the cycle of development of *Paranthrene tabaniformis* Rott.], pp. 87–94, 1 pl., 7 refs. (with a summary in English). *Paranthrene* (*Sciapteron*) *tabaniformis* (Rott.) has damaged white poplar [*Populus alba*] in the Vojvodina region of Yugoslavia in recent years. Investigations on the bionomics of this Aegeriid are described; development lasts two years, and the larvae mine beneath the bark, causing swellings at the points of entry.

Batinica (J.). **Savijači listova voćaka u Bosni i Hercegovini** [Tortricids on fruit trees in Bosnia and Herzegovina], pp. 95–100, 2 pls., 15 refs. (with a summary in English). Notes are given on the seasonal occurrence and injuriousness of some dozen species of Tortricids that roll the leaves of fruit trees in Bosnia and Herzegovina. Those considered in most detail are *Archips* (*Cacoecia*) *rosanus* (L.), *A.* (*C.*) *xylosteanus* (L.), and *Argyroploce variegana* (Hb.).

Mitić-Mužina (N.). **Izvesni momenti iz biologije breskvinog smotavca** [Some aspects of the bionomics of *Cydia molesta* Busck], pp. 101–111, 1 pl., 3 graphs, 9 refs. (with a summary in English). Observations were made on the bionomics of *Cydia molesta* (Busck) on peach near Belgrade

in 1954–55. It was found that the adults of the overwintered generation appear between 7th and 12th May. In the insectary, they lived for 3–15 days, females for longer than males, and the two sexes were about equal in numbers. The females usually laid 30–70 eggs each. The egg, larval and pupal stages lasted 5–9, 14–22 and 9–18 days, respectively, and development lasted about a month in summer and longer in spring and autumn. Larvae of the first two generations developed in new shoots and those of the third, a partial fourth and possibly a partial fifth in both shoots and fruits, preferring the former while they were green and succulent; in young, luxuriant orchards, only the shoots were attacked.

Vaclav (V.). **Značaj parazita jabukinog i šljivinog moljca u smanjenju populacije ovih važnih štetočina u Bosni i Hercegovini** [The importance of parasites of the apple and plum moths in reducing populations of these important pests in Bosnia and Herzegovina], pp. 113–119, 4 refs. (with a summary in English). Plum was severely injured by *Hyponomeuta padellus* (L.) and apple by *H. p. malinellus* Zell. in certain districts in Bosnia and Herzegovina in 1952–54, and the effects of the outbreak were noticeable for several years after it had terminated. Observations at more than 30 points towards the end of the outbreak showed that parasites effected considerable reductions in the populations of larvae and pupae, reaching 85–98 per cent. outside inhabited areas where conditions were optimum for their development. Ichneumonids were the most numerous, and among these *Angitia armillata* (Grav.), *Herpestomus brunnicornis* (Grav.) and *Pimpla turionellae* (L.) (*examinator* (F.)) predominated. An Encyrtid, *Ageniaspis fuscicollis* (Dalm.), and unidentified Tachinids were also of importance. All were reared from both hosts.

Schmidt (L.). **Rezultati bioloških pokusa sa insekticidima protiv pipa vrste** *Otiorrhynchus lavandus* **Germ.** [The results of biological tests with insecticides against the weevil *O. lavandus*], pp. 121–128 (with a summary in English). *Otiorhynchus lavandus* Germ. proved injurious to vines in eastern Croatia in 1955–56, the adults feeding on the buds in spring and the leaves in summer. It also infests forest trees and shrubs, and weeds in the vineyards, so that the danger of spread is great. Control is best directed against the adults as soon as they appear in spring, and various proprietary insecticides were tested for this purpose. Dusts of DDT, BHC or parathion gave good results at concentrations 4–5 times as high as those effective against other insects.

Danon (M.). **Suzbijanje apiona na crvenoj djetelini** [The control of *Apion* on red clover], pp. 129–134 (with a summary in German). Yields of seed of red clover [*Trifolium pratense*] are low in Croatia, and tests were carried out in 1956–57 to ascertain how far they could be improved by applying insecticides against insect pests, notably *Apion* sp., and the best materials to use. A 10 per cent. DDT dust gave good results in the laboratory, and, in a field test on the second cutting, just before flowering, it increased the yield by 11·5–68·8 per cent. Two applications at an interval of 8–10 days were better than one, but there was no advantage in applying the dust at more than 22·5 lb. per acre. The treatment reduced the numbers of *Apion* very considerably.

Adamič (J.). **Crveni pauk, novi problem voćarstva u NR Sloveniji** [Red spider, a new problem in fruit-growing in Slovenia], pp. 135–141, 4 refs. (with a summary in German). Tetranychids have recently increased in importance as pests of fruit trees in Slovenia. *Panonychus ulmi* (Koch) (*Paratetranychus pilosus* (C. & F.)) is the most important. It had seven generations between May and the end of September and was found on numerous fruit trees and other plants, a list of which is given. *Bryobia*

praetiosa Koch was less widely distributed, and *Tetranychus telarius* (L.) (*althaeae* v. Hanst.) also occurred, though it was commonest on hops and garden beans. Infestation was heaviest in well cared-for orchards. In tests of sprays against *P. ulmi*, winter sprays had little effect on hibernating eggs, but sprays applied just before flowering gave good results. Systemic toxicants, particularly demeton (Systox), were very effective and gave control for about two months, and Tedion was the best ovicide. Treatment with a systemic material before flowering and with an ovicide 3–4 times at monthly intervals beginning 10 days after flowering is recommended. If the population still increases, a further systemic treatment should be applied.

Kač (M.). **Crveni pauk u hmeljanicima Savinjske doline i borba protiv njega** [Red spider in hop fields in the Savinja valley and its control], pp. 143–149, 8 refs. (with a summary in German). *Tetranychus telarius* (L.) (*althaeae* v. Hanst.) is widely distributed on hops in Slovenia, and is particularly injurious in the Savinja valley. Observations in recent years showed that the temperature in January–March, particularly that in February, is decisive for the size of the population, and that an early increase leads to more severe damage than a late one. From tests of toxicants, systemic materials (dimefox and methyl-demeton), an ovicide (Tedion) and diazinon are recommended for control. Spray quantities should be liberal, border rows should be sprayed twice, and care should be taken to wet the lower leaves.

Tomašević (B.). **Lukova grinja** (*Rhizoglyphus echinopus* **F. and R.**) [The onion mite (*R. echinopus*)], pp. 151–156, 1 pl., 4 figs., 6 refs. (with a summary in English). *Rhizoglyphus echinopus* (Fum. & Rob.) is an important pest of garlic growing on swampy or well-watered land in Serbia. The bionomics of the mite are briefly described, and tests on its control are recorded. The best results were given by fumigating the bulbs with carbon bisulphide at 20 oz. per 100 cu. ft. for 24 hours at 17°C. [62·6°F.] in winter.

Arčanin (B.). **Biologija crvenog pauka na grahu** [The bionomics of the red spider on beans], pp. 157–166, 4 figs., 5 refs. (with a summary in English). *Tetranychus telarius* (L.) (*urticae* Koch) has become an important pest of beans near Zagreb. Observations in the field at a temperature of 14–24°C. [57·2–73·2°F.] and 40–70 per cent. relative humidity showed that the egg stage lasts 5–6 days and the larval stage, the two nymphal instars and the three quiescent periods ½–1 day each. The adult females oviposited 24–48 hours after pairing and laid an average of 30–60 eggs each at the rate of 2–12 per day. The orange winter females hibernated on poles and in the soil. Infestation of beans began in early June, reached its peak at the beginning of August and declined suddenly at the beginning of September. There were seven generations during the summer of 1957.

Petrik (C.). **Dosadašnji rad na ispitivanju i suzbijanju dudovca u Vojvodini** [Recent work on the investigation and control of *Hyphantria cunea* in the Vojvodina], pp. 183–192, 10 refs. (with a summary in English). This is a review of the spread, ecology, food-plant relations and control of *Hyphantria cunea* (Dru.) in the Vojvodina.

Tadić (M.). **Mogućnosti i perspektive biološke borbe u Jugoslaviji** [The possibilities and future of biological control in Yugoslavia], pp. 193–199, 10 refs. (with a summary in English). The author discusses the use of biological control of insect pests in Yugoslavia. Work has already been done with *Hyphantria cunea* (Dru.); further species that seem suitable for this control method are mentioned.

Masten (V.). *Thomasiniana theobaldi* **Barnes—opasan štetnik malina (prethodno saopštenje)** [*T. theobaldi*—a dangerous pest of raspberry (preliminary communication)], pp. 201–207, 1 pl., 13 refs. (with a summary in German). *Thomasiniana theobaldi* Barnes was found on raspberry in 1956 for the first time in Slovenia, and was heavily parasitised by *Tetrastichus inunctus* (Nees). The infestation was associated with attack by the fungus, *Didymella applanata*. Combined insecticide and fungicide sprays are recommended for control of the Cecidomyiid.

Mendes Ferreira (A.). **Subsídios para o estudo de uma praga do feijão (*Zabrotes subfasciatus* Boh.—Coleoptera, Bruchidae) dos climas tropicais.** [Material for the study of a pest of beans (*Z. subfasciatus*) from tropical climates.]—*Garcia de Orta* **8** no. 3 pp. 559–581, 4 pls., 16 figs., 28 refs. Lisbon, 1960.

Zabrotes subfasciatus (Boh.) is occasionally found in Portugal in beans imported from overseas, and as little was known of its habits, its bionomics were investigated in the laboratory. The author described all stages of this Bruchid, reviews its distribution, food range and natural enemies, and records the results of the work, which are compared with those in the literature. It was found that the life-cycle in beans (*Phaseolus vulgaris*) was completed in an average of 36 days, the eggs hatching in 4 days, larval and pupal development requiring 23 days, and the adults surviving for 9 days at 27°C. [80·6°F.]; the females laid up to 63 eggs each, and ten generations developed in the year. Attempts were also made to rear the Bruchid in other pulses. No eggs were laid on chick-peas (*Cicer arietinum*). Only old females deprived of other substrates oviposited on broad beans (*Vicia faba*); though the eggs hatched, no adults matured, most of the larvae dying in the first instar. Eggs were laid less reluctantly on peas, and development was completed normally, though the resulting adults were small. Oviposition was normal on cowpeas (*Vigna unguiculata* (*sinensis*)) and soy beans, and development was completed on the former as in *P. vulgaris*; the larval and pupal stages were prolonged in soy beans, the resulting adults were small, and the culture died out after three generations. The laboratory cultures, and especially the eggs, were attacked by *Pyemotes ventricosus* (Newp.).

Wildbolz (T.) & Baggiolini (M.). **Über das Mass der Ausbreitung des Apfelwicklers während der Eiablageperiode.** [On the extent of spread of the codling moth during the oviposition period.]—*Mitt. schweiz. ent. Ges.* **32** pt. 2–3 pp. 241–257, 4 figs., 15 refs. Zurich, 1959. (With a summary in French.)

An experiment in Switzerland is described in which 1,000 overwintered larvae and pupae of *Cydia pomonella* (L.) were set out in early June 1958 at a single point among apple trees in an orchard area that was little infested, in order to study the distance to which the newly emerged adults spread. Emergence began on 8th June and continued until 23rd July. The results, which are recorded in detail, showed that subsequent infestation was very heavy in the immediate vicinity of the release point, but fell to only $\frac{1}{10}$ of the rate about 50 yd. away and was no more than normal 150 yd. away. The decrease was greater in the direction of the wind than in the opposite direction. Treeless land on one side of the area arrested flight, but some adults spread to an area of plum trees [*cf. R.A.E.*, A **48**

343] and oviposited. Infestation of pear, even close to the release point, was very low. In all, 50 per cent. of the eggs were laid within a radius of about 60 yd.

Klingler (J.), Vogel (W.) & Wille (H.). **Der Einfluss der Temperatur auf die Eiablage des Apfelwicklers.** [The influence of temperature on the oviposition of the codling moth.]—*Schweiz. Z. Obst- u. Weinb.* **67** pp. 256–262, 5 graphs. Wädenswil, 1958.

It has been taken as a working rule in Switzerland that females of *Cydia pomonella* (L.) lay their eggs on apple at evening temperatures above 15°C. [59°F.]. From field experiments here described in detail, it is concluded that egg-laying activity increases rapidly in intensity between a minimum temperature of about 12°C. [53·6°F.] and an optimum of about 20°C. [68°F.]. It is interrupted by periods of bad weather, strong winds or storms, and is resumed with increased intensity as soon as favourable conditions return.

Wildbolz (T.) & Vogel (W.). **Ueber den Einfluss von intensiver und schonender Insektizidspritzung in Apfelanlagen.** [On the influence of intensive and mild insecticide sprays in apple orchards.]— *Schweiz. Z. Obst- u. Weinb.* **68** pp. 78–86, 4 graphs, 8 refs. Wädenswil, 1959.

Experiments were carried out in apple orchards in several parts of German Switzerland, beginning in 1955, in which some of the trees received a winter spray, a pre-bloom spray against *Cydia pomonella* (L.) and in some years a post-bloom spray, while on others the winter spray was omitted, the pre-bloom spray was applied only when necessary, and ryania was used for it. It was found that the pre-bloom spray could be omitted in most cases and that a post-bloom spray was quite unnecessary. The effect of the reduced schedule on various apple pests is discussed.

Wildbolz (T.) & Staub (A.). **Zur Unterscheidung der auf Obstbäumen auftretenden ausgewachsenen Blattsauger.** [The differentiation of adult Psyllids on fruit trees.]—*Schweiz. Z. Obst- u. Weinb.* **69** pp. 113–117, 11 figs., 4 refs. Wädenswil, 1960.

Various species of *Psylla* occur on fruit trees in Switzerland [*cf. R.A.E.*, A **41** 97], and in this paper the authors show to which groups they belong and give characters permitting the adults to be identified, often by means of a hand lens.

Hurpin (B.). **Biologie de l'insecte: sur la biologie de** *Cetonia aurata* **(Coléop. Scarabeidae).**—*Rev. Zool. agric.* **58** no. 7–9 pp. 106–119, 11 figs.; no. 10–12 pp. 143–153, 5 figs., 7 refs. Talence, 1959.

Adults of *Cetonia aurata* (L.) are common in spring on fruit trees in orchards in France, where they feed on the pollen and damage the flowers. In this paper, the author describes the adults and the larvae, which develop in decaying matter in the soil, and describes detailed observations on the bionomics of the Lamellicorn; the life-cycle lasts two years.

Schvester (D.). **Sur la nocuité du *Phylloxera* gallicole. Incidence de traitements sur la récolte.**—*Rev. Zool. agric.* **58** no. 10–12 pp. 133–136, 1 graph. Talence, 1959.

Since little was known of the effect of infestation by the leaf form of *Phylloxera vitifoliae* (Fitch) on hybrid vines, of which some are very susceptible to attack, observations were made in south-western France in 1959 in a young planting of the hybrid 18–315 SV that had been severely infested in 1958 and showed about 15 primary galls made by the fundatrices per untreated plant in early May. Some of the vines were sprayed in late February with 3 per cent. of an ovicidal product containing 45 per cent. tar distillate and 10 per cent. DNC, and some with an emulsified solution of 0·03 per cent. γ BHC (lindane), applied on 28th May, when the progeny of the fundatrices were appearing and the first new galls were being formed, and again on 5th June; both materials gave complete control of gallicolae. Comparison of grapes from treated and untreated vines during the season showed that control resulted in 15–20 per cent. increase in the weight of the crop and about 20 per cent. increase in the probable alcohol content of the juice.

Roehrich (R.). **Essai d'expérimentation de l'action larvicide en profondeur de l'oléoparathion sur la tordeuse du pêcher (*Grapholitha molesta* Busck.) par infestation artificielle des pousses de pêcher.**— *Rev. Zool. agric.* **58** no. 10–12 pp. 137–138, 3 refs. Talence, 1959.

In a test in France of the effect of a preparation of parathion in oil emulsion of the type known as oleoparathion [*R.A.E.*, A **46** 396] on the larvae of *Cydia* (*Grapholitha*) *molesta* (Busck) in the shoots of peach, newly hatched larvae were placed on leaves at the tips of shoots on comparable trees at various dates, and the shoots were sprayed with 0·015 per cent. parathion 4–7 days after entry had been effected and transferred to the laboratory two days later. Not all the larvae entered the shoots, and few that did so were recovered, but mortality was 82–100 per cent. among the latter, as compared with 7–26 per cent. in untreated shoots.

Anglade (P.), Berjon (J.) & Dupleix (A.). **Essais de traitements sur la ligne de semis du maïs contre la scutigerelle (*Scutigerella immaculata* Newp.).**—*Rev. Zool. agric.* **58** no. 10–12 pp. 139–142, 11 refs. Talence, 1959.

Populations of *Scutigerella immaculata* (Newp.) are known to be distributed to considerable depths in cultivated soil, and observations in south-western France in the spring of 1959 showed equal numbers in four successive 5-in. layers, with young stages predominating in the third from the surface. Survival in the absence of living plants is prolonged, and the usual methods of soil cultivation do not affect populations below the cultivated layer. Normal treatment of the soil with insecticides is thus likely to have little effect and may merely destroy predators, including millepedes of the genus *Lithobius*, which attack *Scutigerella*. Protection of crops by row treatment or seed coatings seems more promising, and the former was tested on maize in south-western France in 1958 and 1959. The results, which are recorded in detail, showed that parathion at about 0·1 oz. per 15 yd. of row, preferably as a liquid, gave good protection and was superior to BHC.

Jørgensen (J.). **Oldenborrerne** *Melolontha melolontha* **L. og** *M. hippocastani* **Fabr.** [The cockchafers, *M. melolontha* and *M. hippocastani*.]— *Tidsskr. Planteavl* **64** pt. 4 pp. 614–687, 4 pls., 15 figs., 44 refs.; also as *Beretn. Forsøgsv. PlKult.* no. 608. Copenhagen, 1960. (With a summary in English.)

The following is based on the author's summary. In Denmark, development of *Melolontha melolontha* (L.) lasts four years, while that of *M. hippocastani* F. requires five years in North Jutland and 4–5 in the south of the country. The distributions of the two species are reviewed, and investigations on their bionomics are described. The larvae are most injurious two years after the flight year, when various crops, particularly root crops, but also woody plants, are damaged. *Beauveria tenella* (*densa*) affords some control in dense populations, and some adults and larvae are destroyed by birds; parasitism of the larvae by *Dexia rustica* (F.) has not been conspicuous of recent years. Experiments on control with insecticides showed that treatment of hedges and forest fringes with γ BHC dust from aircraft or with a spray of DDT and γ BHC from ground machines was very effective against the adults, though the ultimate effects on larval infestation were not known, and that soil treatment with 3·61 lb. aldrin or 4·5 lb. chlordane per acre was very effective against the young larvae when applied in September or April; γ BHC was less effective in soil treatment at 0·9 lb. per acre but seemed satisfactory at 2·25 lb. The possibility of using *Bacillus popilliae* was investigated in 1950–51. The injection of 3–4 cu. mm. suspension, containing between 200,000 and 1,200,000 spores, into the body cavity of individual larvae killed larvae of *M. melolontha* in 18–27 days, but attempts at peroral infection were unsuccessful. Similar results were obtained with larvae of *Amphimallon* (*Rhizotrogus*) *solstitiale* (L.). Larvae of neither of these species became infected when placed in soil containing *B. popilliae* or when the spores were introduced into soil as a powder or a suspension.

Aldhous (J. R.). **Control of cutworm in forest nurseries.**— *Forestry* **32** (1959) no. 2 pp. 155–165, 2 pls., 1 graph, 17 refs. London [1960].

The following is based on the author's summary. Larvae of *Agrotis segetum* (Schiff.) damaged seedlings of Sitka spruce (*Picea sitchensis*) grown on a light loam soil at a nursery near Oxford in 1954. In tests on control in 1957–58, emulsion sprays affording 3 lb. aldrin or 1·5 lb. dieldrin in 100 gal. water per acre gave excellent results, with no damage to the plants, whether applied in mid-June, the time of expected hatching, or in mid-July, when damage was first seen; applications a month later proved effective after three days. In other work, beds containing seedlings of all the conifers commonly grown in Britain were sprayed in mid-July with aldrin and dieldrin at half the above rates. There was no plant injury, and control of *A. segetum* was good.

Crooke (M.). **Insecticidal control of the pine looper in Great Britain. I. Aerial spraying.**—*Forestry* **32** (1959) no. 2 pp. 166–196, 6 figs., 17 refs. London [1960].

The following is virtually the author's summary. An outbreak of *Bupalus piniarius* (L.) occurred at Cannock Chase Forest, Staffordshire, in 1953, causing complete or very severe defoliation over more than 100 acres of Scots pine (*Pinus sylvestris*) of 31 years of age [*cf. R.A.E.*, A **45** 237].

The outbreak was controlled by aerial spraying in the summer of 1954 with DDT at the rate of 1 lb. in 3 gal. liquid per acre [**45** 238]. Similar control action was taken at Culbin Forest, Morayshire, where a threatening population of the looper was present. The two schemes combined totalled some 6,000 acres. No great practical difficulties were encountered, although bad weather and the provision of suitable ground markers for the pilots at Cannock occasioned some delay. Spraying was timed to coincide with the presence of the early-stage larvae, and the starting date for the operation was determined by observing the timing of adult emergence and the rate and timing of hatching from the eggs.

Results were assessed by counts of dead larvae falling to the forest floor after treatment, by pre- and post-treatment counts of larvae in the pine crowns, and by comparison of pre- and post-treatment pupal counts. The spraying operations can be regarded as successful in that population densities in both forests fell to a very low level after treatment and have shown no indication of resurgence, but there is doubt as to whether treatment at Culbin was essential since other populations of the looper in north-eastern Scotland declined during 1954, presumably because of inclement weather during the adult, egg and early larval stages.

Secondary invasion of defoliated trees by *Myelophilus piniperda* (L.) at Cannock necessitated the clear felling or heavy thinning of parts of the crop. No injurious side-effects of these large-scale applications of DDT were noted.

Riches (J.). **Damage to the oat panicle by the frit fly.**—*Ent. exp. appl.* **3** no. 3 pp. 173–184, 1 fig., 25 refs. Amsterdam, 1960. (With a summary in German.)

Oscinella frit (L.) infesting oats in southern England has three generations a year, of which the second attacks the young grains [*cf. R.A.E.*, A **47** 219]. In investigations at Rothamsted in 1958, oats of six varieties were sown four times at intervals of six days from 10th April and half of each plot was sprayed twice, at a fortnight's interval, with DDT against the first generation. The panicles burst between mid-June and mid-July, and about 2,000 were marked between 28th June and 20th July and examined in the laboratory in the following winter. The results showed that attack was greater on the unsprayed than on the sprayed plots, probably as a result of increased panicle density on the sprayed ones, that attack increased as the sowing date was later, that the percentage of blind husks (those containing an unfertilised ovule or nothing but showing no sign of insect damage) was higher on the unsprayed than on the sprayed plots but did not vary with sowing date, that the panicles were larger on unsprayed than on sprayed plots, especially on the late-sown ones, and that there were varietal differences on the percentage of blind grains. Attack was greater on main grains than on bosom grains [*cf.* **47** 220], and association of attacked bosom grains with attacked main grains was far more frequent than would result from random distribution of attacked bosom grains. The factors responsible for blindness are discussed, and one type is considered due to early attack on the immature grain by *O. frit*.

Laughlin (R.). **Biology of *Tipula oleracea* L.: growth of the larva.**— *Ent. exp. appl.* **3** no. 3 pp. 185–197, 2 graphs, 9 refs. Amsterdam, 1960. (With a summary in German.)

The results are given of laboratory investigations on the growth of the larvae of *Tipula oleracea* L., as an introduction to further papers on the

causes of variation in growth. It was found that larval development under constant conditions at 21°C. [69·8°F.] lasts from 4–5 to 16–17 weeks, with an average of 8·8 weeks for larvae reared in groups; 90 per cent. pupated in 3–6 weeks, and most of the variation occurred in the fourth instar. Isolated larvae developed more slowly than those in groups. Males and females occurred in equal numbers, but the former pupated about a week sooner than the latter. Increase in weight was exponential during the first three instars. Weight was doubled on the average every 3–4 days during these instars and increased by 1·5 mg. per day during the first part of the fourth instar, but decreased during the week preceding pupation, when the gut was emptied. The weight of the pupa was about half the maximum larval weight. Some larvae, however, maintained their maximum weight for a month before a decrease set in.

Gupta (P. D.) & Thorsteinson (A. J.). **Food plant relationships of the diamond-back moth (*Plutella maculipennis* (Curt.)). I. Gustation and olfaction in relation to botanical specificity of the larva.**—*Ent. exp. appl.* **3** no. 3 pp. 241–250, 12 refs. Amsterdam, 1960. (With a summary in French.)

The following is based on the authors' summary. The food-plant range of *Plutella maculipennis* (Curt.) has been shown in Canada to be essentially coincident with the botanical distribution of mustard oils and their glucosides [*R.A.E.*, A **42** 194]. The exclusion of some species is determined not only by the infrequency of adequate stimulants for feeding, but also by a high frequency of occurrence of feeding inhibitors. A few plant species lack feeding inhibitors, but are excluded by a deficiency of feeding stimulants. Some plants are devoid of decisive feeding inhibitors and contain effective feeding stimulants, but yet are excluded as food-plants by the possession of toxic principles. At least one plant species, *Pisum sativum* (pea), devoid of mustard oil glucosides, is sufficiently palatable, nutritious and free of toxicants to support successive generations of *Plutella* larvae in the laboratory. The free mustard oils in the natural food-plants apparently tend to inhibit dispersal of the larvae.

Proceedings of the IVth International Congress of Crop Protection, Hamburg, September 1957. Section III. Warning services and forecast.—*Proc. IVth int. Congr. Crop Prot.* **1** pp. 169–255. Brunswick, 1959. **Section IV. Viruses and virus diseases.**—*T.c.* pp. 257–400. [Recd. 1961.]

The following are abstracts of selected papers containing hitherto unpublished information of entomological interest, of which the text is printed in these sections.

Ehrenhardt (H.). **Untersuchungen zur Prognose der Obstmadenbekämpfung im südwestdeutschen Raum** [Investigations on forecasting for codling-moth control in south-western Germany], pp. 247–251, 4 graphs, 6 refs. The forecasting of dates for the application of sprays against *Cydia pomonella* (L.) on apple is difficult in a region with a varying climate. In the Palatinate, where temperatures are higher in the Rhine plain than in the higher-laying western part, emergence of adults of the overwintered

generation occurs eight days later in the south of the plain than in the north and a further 8–14 days later in the hilly west, with still further local variations. The problem is later complicated by the occurrence of a second, partial, generation in late summer. In the plain, this was only half as important as the first generation in 1954, but as important in 1955, although the weather was not particularly favourable in either year. Forecasting thus requires special care. Observations in 1954 showed that light-traps were more reliable than bait-traps, but laborious to operate, and that emergence from caged larvae was the simplest indication. To test the reliability of this method, larvae that had spun cocoons in corrugated cardboard in the autumn of 1954 were exposed at the end of winter in cages facing all four points of the compass. Inspection of the curves of emergence showed that about average results were obtained from the cages facing east or west. When a cage facing east was compared with the previous arrangement and with tree stumps on which larvae were induced to spin cocoons in cracks in the bark, it was found that emergence was earlier from the cage facing east than was indicated by the average for the four, and latest from the stumps. The results from a cage facing east agreed fairly well with catches in an automatic light-trap for the second generation, emergence beginning about a week before the first captures. Oviposition was found to occur within about 2–4 days after emergence in summer, and hatching after a further 6–12 days. Sprays of lead arsenate, DDT, parathion and a mixture of the last two were applied on 15th June, when first-generation larvae were hatching in the rearing cages, on 4th July, at the time of transition to the second generation, and on 9th and 18th August, against the second, or on some of these dates only. The best control was given by lead arsenate, of which one application on 15th June and one on 4th July proved superior to 3–4 of the other materials, and the timing appeared satisfactory.

van Hoof (H. A.). **Betrachtung über die Übertragung nichtpersistenter Viren** [Considerations on the transmission of non-persistent viruses], pp. 267–269, 4 figs., 6 refs. The author describes observations on the way in which the stylets of aphids (*Aphis fabae* Scop. and *Myzus persicae* (Sulz.)) penetrate the epidermis of the leaves of broad bean (*Vicia faba*). The time required varied considerably, and was in one instance as short as 15 seconds. The pendulum-like movement of the stylets showed a frequency of about 1 sec. When 20 examples of *M. persicae* were used to transmit lupin mosaic to broad beans after a feed of 15 secs. on the source of the virus, 15 did so. Since the infecting feed was so short, it was not certain whether the cell wall was penetrated, and it appeared that in many cases the virus was taken up from the wall itself.

Vasudeva (R. S.) & Sahambi (H. S.). **Phyllody diseases transmitted by a species of** *Deltocephalus* **Burmeister,** pp. 359–360, 3 refs. A phyllody disease of sesamum (*Sesamum orientale*) in India is transmitted by *Deltocephalus* sp. [*cf. R.A.E.*, A **45** 504]. Tests showed that the virus undergoes a latent period in the vectors ranging from 11–20 days in June–August to 37–62 days in November–February. Cicadellids in which the latent period had been completed remained infective for the rest of their lives. Symptoms in the plants appeared after 13–27 days in May–October and after 30–55 days in November–March. The virus could be acquired by nymphs and transmitted after completion of the latent period. Since sesamum is a short-season crop and the life-span of *Deltocephalus* is not more than 3–5 months, other plants were tested for susceptibility to the virus. It was transmitted by *Deltocephalus* to sann hemp (*Crotalaria juncea*) and various crucifers, on all of which symptoms of phyllody were observed in the field.

Twaalfde Internationaal Symposium over Fytofarmacie en Fytiatrie. 26 April 1960. [Twelfth International Symposium on Phytopharmacy and Phytiatry, 26th April 1960.]—*Mededel. LandbHogesch. Gent* **25** nr. 3–4 pp. [8+] 981–1563, illus., refs. Ghent, 1960.

The following are abstracts of papers read at this meeting.

VAN LAERE (O.). **De bestrijding der bijenacariose bij middel van Keltane** [The control of bee acariosis by means of Kelthane]. pp. 1515–1520. 3 refs. (with summaries in French, English & German). *Acarapis woodi* (Rennie) infesting honey bees has been successfully controlled by fumigation of the hives with DMC (Dimite) and chlorbenzilate, which are harmless to the bees themselves but must be applied several times for good results, since they are not effective against all stages of the mite. Kelthane has similar properties and was tested in the laboratory and field in Belgium. It was mixed 1:2 with sawdust, and potassium nitrate added, to form combustible tablets, which were ignited by means of a fuse and inserted into the hive in the evening after all the bees had returned; an exit was blown in and the hive closed for 30 minutes. In one hive, treated five times at 6-day intervals, beginning on 27th March 1959, there were still a few living mites and eggs on the bees after the second treatment, but mortality of adults was 97·6 per cent. Inspection in May 1960 showed that the bees were free from mites. Similar results were obtained at another locality.

COUTIN (R.) & ARNOUX (J.). **Signification écologique des captures par piégeage lumineux d'imagos de *Laspeyresia pomonella* L.**, pp. 1521–1531. 7 graphs, 17 refs. Light-traps furnished with a mercury-vapour lamp were tested in apple orchards at several places in the Sarthe department in France in 1958–59 for their ability to supply reliable information on the population of *Cydia* (*Laspeyresia*) *pomonella* (L.). It was found that catches were small and somewhat irregular, and that males predominated in them, but the females taken had mostly not oviposited. The results obtained in the various years and places are analysed statistically, and it is concluded that the traps show promise, although the method is not as yet sufficiently precise for deciding the dates of insecticide treatments.

EHRENBARDT (H.). **Weitere Untersuchungen zur Intensivierung der Warndienstprognosen bei *Cydia pomonella* mit Hilfe von Lichtfallen** [Further investigations on the intensification of the warning service for *C. pomonella* with the help of light-traps], pp. 1532–1550. 5 figs., 4 refs. Since the course of emergence of adults of *Cydia pomonella* (L.) in cages facing different directions or on tree stumps does not entirely correspond with that obtaining in apple orchards and gives no information as to numbers or the length of the flight period, observations in the Ukraine [cf. *H.A.E.*, A **49** 516] were continued with light-traps. A specially designed trap was used in 1958–59 in which the vertical light tube was protected by a transparent cover permitting the passage of ultraviolet light, in which there were slits that allowed the moths to enter, they then passed through a funnel fixed below into the collecting cage. An ultraviolet lamp gave the best results, and examples of the course of trapping are given. Such traps are useful adjuncts to emergence cages.

DE WILDE (J.), STUART (R.) & BOXEMAN (W.). **A comparative study of feeding and oviposition preference in the Colorado beetle [*Leptinotarsa decemlineata* Say]**, pp. 1845–1846. 2 figs., 5 refs. In experiments in Holland, four species of solanaceous plants, potato, *Solanum dulcamara*, *S. luteum* and tomato, were compared with respect to the feeding and oviposition of *Leptinotarsa decemlineata* (Say). When newly hatched larvae were reared on the leaves, development to the pupal stage required

17·7, 19·9, 24 and 22·3 days and the mortality percentages were 23, 33·7, 99·6 and 77·2, respectively; *S. luteum* appeared to be toxic to the larvae, and tomato was largely rejected. When series of seven females ovipositing regularly were confined for five days on potato alone, potato with one of the other plants, and the other plant alone, they laid 1,835 eggs on potato alone, 1,303 on potato and 286 on *S. dulcamara*, and 1,475 on *S. dulcamara* alone; 2,164 on potato alone, 1,184 on potato and 845 on tomato, and 832 on tomato alone; and 1,524 on potato, 127 on potato and 602 on *S. luteum*, and 494 on *S. luteum* alone. In feeding tests with adult females, a preliminary period on one plant immediately after adult emergence tended to establish a preference for that plant and reduced the amount of subsequent feeding on others.

Hafez (M.). **Some biotic factors affecting the population of the cabbage aphid, *Brevicoryne brassicae* L., in the Netherlands in 1959,** pp. 1347–1350, 3 refs. Observations in Holland in 1959 showed that the population of *Brevicoryne brassicae* (L.) was very low until the first week in June, when it began to increase, first on cauliflower and then on brussels sprouts. It reached a peak in late July and then decreased suddenly, reaching a minimum in mid-August. It increased again in the second half of August and reached a much higher peak than before in early October. It then declined until at the end of the year winter eggs were almost the only stage present, on the brussels sprouts. The predators present were Coccinellids (especially *Coccinella septempunctata* L.) and larvae of Syrphids, Chrysopids and the Cecidomyiid, *Phaenobremia aphidovora* (Rübs.), and these probably contributed to the decline in July; they were completely absent later in the season. The only parasite found was *Diaeretus rapae* (Curt.). Parasitism by this Aphidiine was 1 per cent. in early June, 40 per cent. in mid-July, 9 per cent. in late July, 60 per cent. in mid-August, 4 per cent. in mid-September, 30 per cent. in early October and about 12 per cent. later in the year. It was itself parasitised by a species of *Charips*, possibly *C. ancylocerus* (Cam.), and by two unidentified Pteromalids that deposited their eggs externally in the last larval instars or later stages of both *D. rapae* and *Charips* sp. within the dead aphid. These hyperparasites entered diapause earlier than did *D. rapae*, which led to the increased parasitism of *B. brassicae* in September and October, and emerged later in spring, permitting a high degree of parasitism of the fundatrices on the overwintered brussels sprouts.

Cessac (M.). **Caractéristiques originales de l'endothion, insecticide systémique, dans ses applications agricoles et horticoles,** pp. 1351–1357, 5 refs. The author describes the properties of endothion, a systemic acaricide of good immediate but little residual effect on the mobile stages of mites and of good immediate and residual effect on aphids. Its effectiveness against the latter is illustrated from the results of tests in France against *Aphis fabae* Scop. on broad beans [*Vicia faba*], *A. fabae* and *Myzus* (*Myzodes*) *persicae* (Sulz.) on beet, *M. persicae* on potato and *Macrosiphum rosae* (L.) on rose, in which it proved about as effective as methyl-parathion. Endothion is also effective against the mining larvae of certain Diptera, including *Pegomyia betae* (Curt.) on beet and *Platyparea poeciloptera* (Schr.) on asparagus; tests against the latter are described. It is not very toxic to honey bees or to Coccinellids or Syrphids that prey on aphids; its vapour pressure is very low, so that the risk of an accumulation of toxic vapours is slight, and its toxicity to warm-blooded animals is not great; it is very soluble in water, and can be supplied in soluble sachets ready for incorporation in sprays, so that direct handling and incorrect dosage are avoided.

Hennequin (J.). **Moyens de lutte chimique contre la mouche de l'asperge (*Platyparea poeciloptera* Schr.)**, pp. 1358–1369, 9 figs., 23 refs. Tests have been carried out in France since 1955 on the control of *Platyparea poeciloptera* (Schr.) on asparagus that has not yet come into production [*cf.* **49** 92, etc.]. In cage tests, sprays of dimethoate (Rogor) at 0·02 or 0·04 per cent. proved rather more effective than endothion at 0·05 per cent. against first- and second-instar larvae [*cf.* **49** 93], giving 88 and 93 per cent. corrected mortality, as compared with 83 per cent., 0·03 per cent. diazinon was somewhat less effective, and 0·05 per cent. mevinphos (Phosdrin) and 0·02 per cent. phosphamidon gave poor results; mortality of third-instar larvae was low. Dimethoate was also very effective against adults one day after application, but not later, and better than endothion, trichlorphon (Dipterex) or diazinon [*cf.* **47** 110]. When dimethoate and endothion, which have a systemic effect, were applied to the shoot bases, both gave fairly good kills of larvae in the tips after two days, but toxicity then declined sharply. In field tests in 1956 and 1959, in which the criterion was the number of pupae found in the stems, 0·02 per cent. diazinon was significantly better than 0·02 per cent. γ BHC or 0·05 per cent. methyl-demeton in 1956, and 0·05 per cent. endothion was superior to 0·03 per cent. diazinon or 0·025 per cent. methyl-demeton, and much better than 0·05 per cent. mevinphos, the only systemic insecticide at that time authorised for use on vegetables, in 1959.

Emmel (L.). **Über ein neuartiges Akarizid auf Basis von Dinitroalkylphenylacrylat** [On a new acaricide on a basis of dinitroalkylphenyl acrylate], pp. 1370–1376, 4 refs. Search in Germany for an acaricide differing in mode of action from phosphorus compounds or chlorinated hydrocarbons led to the preparation of a dinitroalkylphenyl acrylate, referred to as Hoechst 2784 or Acricid. It has a melting-point of 67°C., and a molecular weight of 322, is soluble in organic solvents, but not in water, and is decomposed in alkaline media. Tests showed that it is effective against the mobile and resting stages of Tetranychids, principally *Tetranychus telarius* (L.) (*urticae* Koch), at concentrations as low as 0·006 per cent., acting by contact and penetrating the integument rapidly, and also has a toxic effect on the young eggs, arresting embryonal development. It proved effective against the winter eggs of *Panonychus* (*Metatranychus*) *ulmi* (Koch), though a higher concentration was required then against the summer eggs. Initial mortality increased with concentration, and temperature had little effect, though mortality was delayed at low temperature. The material also has a fumigant effect on mites, though not on the eggs. In a test against a strain of *Tenuipalpus* sp. resistant to organophosphorus compounds, 0·025–0·012 per cent. sprays gave complete kill, as compared with only 23–26 per cent. for a systemic phosphorus compound, and good results have been reported from field tests in various countries against phosphorus-resistant strains of *P. ulmi* and *Tetranychus telarius*. The material has little effect on insects, including honey bees, though it proved toxic to thrips of several species, but it has fungicidal properties; it is not particularly toxic to laboratory animals and does not leave very persistent residues on fruits.

van den Bruel (W. E.), Pietermaat (F.), Bollaerts (D.) & Stefens (P.). **Recherches sur la destruction au moyen d'un champ électrique à très haute fréquence des insectes xylophages forant les bois ouvrés**, pp. 1377–1391, 9 figs., 3 refs. (with a summary in English). The following is based on the authors' summary. A detailed account is given of tests in which larvae, chiefly those of *Tenebrio molitor* L., were introduced into holes in wood and subjected to high-frequency radiation of an ultra-short wavelength emitted by an apparatus having two electrodes in the form of metal sheets that are

fitted to both sides of the material to be treated. Good results were obtained, the duration of treatment required depending on the thickness of the wood, and it is suggested that the method may have wide application, being suitable for the treatment not only of structural timbers, but also of works of art.

van Dinther (J.). **Bestrijding van rijstboorders in Suriname** [Control of rice borers in Dutch Guiana], pp. 1531–1541, 5 refs. (with a summary in English). *Diatraea saccharalis* (F.) and *Rupela albinella* (Cram.) are important pests of rice in Dutch Guiana, and investigations in 1958–59 showed that stalks bored by them produce an increased number of empty grains and a decreased yield, though the quality of the harvested rice is not impaired. Losses were moderate, and *Rupela* far outnumbered *Diatraea* in frequency. In experiments on control, atomised emulsion sprays of endrin and an unspecified chlorinated hydrocarbon failed to increase the yield significantly when applied in May–June, apparently owing to high winds and rain, and similar sprays of endrin and malathion and a BHC dust applied repeatedly in November–January, though largely ineffective against the borers, increased the yield, mainly by controlling *Chloriona* (*Sogata*) *orizicola* (Muir) and *Dracculacephala clypeata* Osb., two very harmful rice pests.

van Eyndhoven (G. L.) & Groenewold (H.). **On the morphology of *Steneotarsonemus pallidus* and *S. fragariae* (Acar. Tars.).**—*Ent. Ber.* **19** no. 6 pp. 123–124, 4 figs., 7 refs. Amsterdam, 1959.

In the apparent absence of distinguishing characters, *Steneotarsonemus fragariae* (Zimm.), which was described from strawberry, has been considered a synonym of *S. pallidus* (Banks), described from *Cyclamen* [*cf. R.A.E.*, A **23** 243]. Conflicting results have been recorded, however, in attempts to transfer the mites from one plant to the other. Mites from strawberry were successfully transferred to *Cyclamen* by Ewing & Smith in the United States [*loc. cit.*], but not by Massee in Britain or Wiesmann in Switzerland [**30** 90], and mites from *Cyclamen* were transferred to strawberry by Boyd & Hodson in Britain [**24** 362]. In experiments by the junior author in Holland, mites from *Cyclamen* did not become established on strawberry, or those from strawberry on *Cyclamen*. Damage was caused initially, but the populations later disappeared. In the laboratory, mites from *Cyclamen* laid only very few eggs on strawberry. Furthermore, they were able to settle on ivy (*Hedera*), which was impossible for mites from strawberry. Morphological examination by the senior author of material from Holland and Belgium showed the presence of a differentiating character in the third dorsal seta, which was longer in the mites from *Cyclamen* than in those from strawberry and also differed somewhat in form. It is therefore concluded that the strawberry mite, *S. fragariae*, is distinct from the *Cyclamen* mite, *S. pallidus*.

Kalshoven (L. G. E.). **Investigations of the initial infestation of new teak plantations by the trunk-inhabiting termite, *Neotermes tectonae* Damm., in Java.**—*Ent. Ber.* **19** no. 7 pp. 138–143, 3 refs. Amsterdam, 1959.

Surveys of teak trees in plantations 5–12 years old were made in Java in 1935–37 to investigate the distribution of colonies of *Neotermes tectonae* (Damm.), which are initiated in dead wood in the crowns [*cf. R.A.E.*, A

49 444, etc.]. It was found that a plantation only five years old may be slightly infested, though no outward signs are visible. External signs appeared in one tree six years old, which had probably been attacked three years previously, and 1–2 per cent. of the trees in parts of plantations seven years old were sometimes infested. The percentage reached 9 in plantations 8–10 years old, and 30 in those 12 years old. After the trees have reached the age of ten years, infestation is likely to occur throughout a plantation. Alates that swarm and found new colonies first occur in plantations seven years old, after which internal spread is possible. Primary infestation is not confined to the edge of a plantation, but occurs irregularly throughout it. The reasons for the irregularity [*cf.* **46** 319] are discussed; wind appeared not to be a factor.

Cellier (K. M.). **Considerations in experiments for the control of codling moth (*Cydia pomonella* (L.)) in apples.**—*Aust. J. agric. Res.* **11** no. 2 pp. 186–196, 2 graphs, 16 refs. Melbourne, 1960.

The following is almost entirely the author's summary. A study was made in South Australia of some of the aspects to be considered in experiments on the control of *Cydia pomonella* (L.) on apple. Examination of the number of fruits damaged by either deep entries or punctures in samples of 100 fruits showed that the counts of damaged fruits could be considered as random samples from a Poisson (or binomial) distribution both within trees and also in plots up to a size of four test trees. An optimum plot size and sampling procedure was determined in experiments on control of a strain of *C. pomonella* resistant to DDT, the results of which have been noticed [*R.A.E.*, A **46** 323]. A single-tree plot with four samples per tree was found to be optimum for unguarded plots, and plots of either one, two, three or four trees with four samples per tree are satisfactory for guarded plots where the trees are hand-sprayed. Guarding seems an unnecessary safeguard and expense for hand-sprayed plots. Where Air-Blast spray machines are used, large plots with a double guard row are necessary, and it is sufficient to examine 2–4 samples per tree. It is suggested that the heterogeneity law due to H. F. Smith can be used to obtain the optimum plot size in experiments for the control of insect pests, and possibly of diseases, on fruit trees. No reduction in experimental error was obtained by using the crop size of individual trees as a covariate in an analysis of covariance [*cf.* **24** 497].

Martin (B. H.) & Black (R. F.). **Heat treatment of *Citrus* for control of red scale. I. Trials on Washington navel fruit in a dehydrator.**—*Aust. J. agric. Res.* **11** no. 2 pp. 197–207, 4 graphs, 9 refs. Melbourne, 1960.

The following is based almost entirely on the authors' summary. Heat treatments at temperatures ranging from 50 to 70°C. [122 to 158°F.] for various durations were carried out in 1957 in New South Wales on freshly picked Washington navel oranges infested with *Aonidiella aurantii* (Mask.). Counts of the living and dead Coccids were made three weeks later. The time-mortality curves were approximately sigmoidal and similar to normal dosage-mortality curves. Complete mortality was reliably obtained after treatment periods ranging from one hour at 70°C. to 2½ hours at 50°C. However, damage to the fruits at 70°C. was severe and resulted in less than the time required for complete mortality of *A. aurantii*, whereas at 50°C. no fruit damage occurred until after this time and even then it was very slight. Raising the relative humidity of the treatment chamber from 12

to 40 per cent. did not significantly alter the time required for either 50 or 100 per cent. mortality at 50°C. It is considered that the kill was an effect of temperature rather than of dehydration, and that it probably occurred at a fairly similar threshold temperature in all the treatments used.

Hadlington (P.) & Gardner (M. J.). *Diadoxus erythrurus* (**White**) (**Coleoptera—Buprestidae**), **attack of fire-damaged** *Callitris* **spp.**—*Proc. Linn. Soc. N.S.W.* **84** (1959) pt. 3 pp. 325–331, 1 pl., 16 refs. Sydney, 1960.

Timber of *Callitris* spp., particularly *C. hugelii* (*glauca*), from fire-damaged forests in New South Wales is consistently found to be injured by *Diadoxus erythrurus* (White) [*cf. R.A.E.*, A **20** 673; **30** 232], and, although it is still suitable for constructional purposes, the disfiguring effect of the large emergence holes limits its use. Observations on the bionomics of the Buprestid were made in three forests that were damaged by fire in November 1951 or December 1957. The larvae feed first in the phloem and cambium, which they may girdle if very numerous or present in successive years, and later in the inner bark; they pupate in the sapwood. Total development lasted three months in summer and ten or more for the overwintering generation, of which the adults emerged in September–October. Adults are present from September to April and larvae throughout the year. Females oviposited in the fire-damaged bark but the larvae developed only where the damage was localised and they were able to spread into the healthy tissues; infestation in the upper parts of the trees, which were not affected by fire, were negligible. Attack also followed mechanical damage during logging, and it was observed on trees weakened by aphid infestations or defoliated by *Zenarge turneri* Rohw. Many trees damaged by fire recovered after appreciable rainfall. Some of these eventually died and were found to be completely girdled by *D. erythrurus*. The others often showed signs of attack, but the copious flow of resin produced after rain prevented establishment of the larvae. By destroying the cambium, the larvae prevent the production of resin canals in the infested area, but resin from canals near it is sufficiently abundant after rainfall to exclude the larvae from the healthy tissue. *Cupressus macrocarpa* var. *lambertiana* is also attacked, even though undamaged; its resin is of a different type and apparently does not hinder infestation. In June 1952, Clerid predators and seven parasites, of which *Doryctes diadoxi* Nixon was the most abundant, were collected in the larval galleries or on the bark of *Callitris*. They considerably reduced the numbers of *Diadoxus* before the rainfall and were abundant immediately afterwards, but were later markedly scarcer, presumably owing to the effect of the resin on the host.

Zondag (R.). **Attack by** *Calotermes brouni* **Frogg. on living** *Pinus radiata*. —*N.Z. Ent.* **2** no. 4 pp. 15–17. Nelson, N.Z., 1959.

The following is based mainly on the author's synopsis. The native dry-wood termite, *Calotermes brouni* Frogg., was found attacking living overmature pine trees (*Pinus radiata*) in New Zealand in 1956–58. Observations showed that infestation starts in dead branches and snags and may continue into the heartwood. Most severely attacked trees are unsuitable for conversion to sawn timber. Unhygienic conditions and lack of silvicultural attention tend to enhance the danger of attack in overmature stands. No infestation by this species or by introduced Australian termites has been reported from any of the large exotic plantations.

Taylor (R. W.). **The Australian ant** *Iridomyrmex darwinianus* **(Forel) recorded from New Zealand.**—*N.Z. Ent.* **2** no. 4 pp. 18–19, 3 refs. Nelson, N.Z., 1959.

The Australian ant, *Iridomyrmex darwinianus* (Forel), was found near Auckland, New Zealand, in 1959. It was thought by some to be the Argentine ant, *I. humilis* (Mayr); the latter is not known to be present in New Zealand.

Manson (D. C. M.). **An insect and a mite new to New Zealand.**—*N.Z. Ent.* **2** no. 4 pp. 31–32, 1 fig., 1 ref. Nelson, N.Z., 1959.

In February 1957, a larva of *Cosmotriche* (*Philudoria*) *potatoria* (L.) was found in New Zealand on *Hydrangea* plants from Holland. It showed no inclination to feed on *Hydrangea*, but subsequently ate cocksfoot (*Dactylis glomerata*), on which it completed its development. This Lasiocampid is widespread in Europe, where it feeds on coarse grasses.

Calacarus (*Eriophyes*) *carinatus* (Green) was found on the leaves of *Camellia* plants in the Gisborne area in April 1958, apparently for the first time in New Zealand.

Hoy (J. M.). **Collection of** *Hylemyia seneciella* **(Meade) (Diptera: Muscidae) in 1959 season.**—*N.Z. J. Sci.* **3** no. 1 pp. 100–102, 1 ref. Wellington, N.Z., 1960.

Following a request from Australia for further supplies of *Hylemyia seneciella* (Meade) for use against ragwort [*Senecio jacobaea*] [*cf. R.A.E.*, A **47** 207], some 20,000 puparia obtained from inflorescences of the weed collected in New Zealand during January and February 1959 were forwarded by air on 3rd March, arriving the next day. The rearing method adopted was in general similar to that previously used [**47** 208] but, in order to avoid injury to the puparia, these were recovered from the sand trays by means of a flotation technique. After coarse plant débris had been removed from the surface of the sand, successive layers of sand were placed in turn in a vertical-sided vessel containing 3–4 gal. water and the puparia removed by means of a plastic scoop or a sieve (12 mesh per linear inch). They were then dried on blotting paper, those from the lower layers first being washed, and stored in washed sand in small plastic dishes until required for shipment, when they were again recovered by the flotation technique and packed in layers in lightly moistened vermiculite in a wooden container. It was subsequently learned that the sieving technique previously used for recovery did not result in a significant proportion of abnormal adults; a total of 2,873 adults emerged from the 4,000 puparia dispatched in 1958 [**47** 208].

Hoy (J. M.). **Establishment of** *Proceedochares utilis* **Stone (Diptera: Trypetidae) on** *Eupatorium adenophorum* **Spreng. in New Zealand.**—*N.Z. J. Sci.* **3** no. 2 pp. 200–208, 6 figs., 5 refs. Wellington, N.Z., 1960.

Eupatorium adenophorum is established as a noxious weed of grazing land in several countries, notably Jamaica, Hawaii [*cf. R.A.E.*, A **48** 333], Australia and New Zealand, where it occurs over extensive areas in the

north of the North Island. Dense stands are most frequent on bush margins, but the weed also grows along stream beds, among scattered *Leptospermum scoparium*, on slopes covered with *Pteridium esculentum* and, occasionally, in open *Danthonia* pasture. Attempts to control it by cultural methods or weed-killers were not satisfactory, and since in 1956 the Trypetid, *Procecidochares utilis* Stone [*loc. cit.*], which had been introduced into southern Queensland from Hawaii against *E. adenophorum* four years previously, was widely dispersed and causing extensive galling of the plant there despite heavy attack by native parasites, an attempt was made in 1958 to introduce it into New Zealand. Only adults were forwarded, in order to avoid the introduction of parasites, and 621 were dispatched by air from Queensland in three consignments during October. Of the 580 adults surviving at the time of liberation, 292 were released in the centre and 288 near the edge of a stand of *E. adenophorum*, *Pteridium esculentum* and *L. scoparium*, some 5,000–6,000 acres in extent, on the Coromandel Peninsula. By May 1959, galls were thinly dispersed over a radius of 200 yd. from the central liberation point and uniformly over the patch of plants, about 100 × 20–30 yd. in extent, that formed the other release site; galls were also found on roadside plants for a distance of 500 yd. on either side of the latter. Two generations of the Trypetid had been produced. By July, further galling had occurred at both sites and some galls were found at a distance of 300 yd. from the central liberation point. There was no sign of parasitism.

Spiller (D.). **Toxicity of pentachlorophenol to the common house borer *Anobium punctatum* De Geer. II. A trial of effectiveness, 1951–1960.** —*N.Z. J. Sci.* **3** no. 3 pp. 534–538, 3 refs. Wellington, N.Z., 1960.

The following is based almost entirely on the author's summary of this part of a series on the value of pentachlorophenol against *Anobium punctatum* (Deg.) in timber in New Zealand [*cf. R.A.E.*, A **38** 261]. Pentachlorophenol at concentrations of 5, 3·5, 2, 1, 0·5 and 0·2 per cent. in power kerosene was used for dip treatment of blocks of sapwood of *Podocarpus dacrydioides* in October 1951. The treated blocks were caged individually in the following December–January, and numbers of adults, sometimes amounting to several hundreds, were added to each cage in most years of the test. In all treatments, some blocks became infested during the first year, when the four lower concentrations failed completely. Although the highest concentration gave some protection for eight years, pentachlorophenol cannot be considered very effective against *Anobium*, and it is concluded that its use should be discontinued.

Spiller (D.). **A study on control of infestations of the common house borer *Anobium punctatum* De Geer. Part 2. A test of diesel oil and fractions 1953–60.**—*N.Z. J. Sci.* **3** no. 3 pp. 539–542, 1 ref. Wellington, N.Z., 1960.

The following is almost entirely the author's summary of this part of a series [*cf. R.A.E.*, A **40** 306]. In experiments in New Zealand, a diesel oil (gas oil) was fractionated into three approximately equal portions, which, with the parent oil, were tested for control of infestation by *Anobium punctatum* (Deg.). The oils were applied as single brush coats to infested boards cut from sapwood of *Podocarpus dacrydioides*, and beetle emergence was observed for seven years. The light fractions gave good initial control, but

the treated boards soon became reinfested; the heavy fraction was ineffective initially, but thereafter gave perfect protection. These results indicate that diesel oil owes its effectiveness to a combination of properties and that no spectacular improvement in effectiveness could be achieved by moderate fractionation or refining. The parent oil gave effective control, the slight reinfestation that occurred being insufficient to maintain the *Anobium* population.

Bondar (G.). **Insetos "serradores" e o "serrador" de cacau.** [Sawing insects and the cacao sawyer.]—*Agronomia* **17** pp. 75–78, 3 figs. Rio de Janeiro, 1959.

Inspection of a cacao plantation 3–5 years old in Pará, Brazil, in October 1956 showed that numerous young plants had been cut at various heights in the manner typical of certain Longicorns at oviposition. No insects were present, but investigations in the following year showed that a Lamiid identified as *Ecthoea quadricornis* (Ol.) was responsible. The female is described, and the collection and destruction of infested material is recommended for control.

Gonçalves (C. R.). **Distribuição, biologia e ecologia das saúvas.** [Distribution, bionomics and ecology of leaf-cutting ants.]—*Agronomia* **18** no. 3 pp. 26–39, 10 figs., 3 maps, 29 refs. Rio de Janeiro, 1960.

This is essentially a review of the distribution of the species of leaf-cutting ants of the genus *Atta* in Brazil, based largely on investigations by the author. The most widely distributed and injurious is *A. sexdens* (L.), which has four subspecies.

Mariconi (F. A. M.) & Paiva Castro (U.). **Resultados preliminares do combate à saúva com alguns formicidas modernos.** [Preliminary results in the control of leaf-cutting ants with modern formicides.]—*Biológico* **26** no. 9 pp. 179–183, 14 refs. São Paulo, 1960.

Experiments on the control of the common leaf-cutting ant, *Atta sexdens rubropilosa* Forel, were carried out on 11 rural properties near Piracicaba, São Paulo, in 1960. A 2·5 per cent. aldrin dust, emulsion concentrates of aldrin and chlordane diluted to 0·6 and 1·5 per cent. toxicant, respectively, and a mixture containing 31 per cent. methyl bromide and 29 per cent. ethylene dibromide were introduced into the openings of different nests at suitable rates, and the results were estimated at intervals. At the last inspection, 118–119 days after treatment, none of the materials had killed all the colonies, and when the nests in which activity had apparently ceased were excavated, it was found that the percentages of colonies actually killed were 12·5, 75, 42·8 and 0, respectively.

Falanghe (O.) & Dias Netto (N.). **Inseticidas para combater a broca da figueira.** [Insecticides for control of the fig borer.]—*Biológico* **26** no. 10 pp. 195–198, 3 refs. São Paulo, 1960.

Azochis grypusalis Wlk. is widely distributed on fig in São Paulo, and the larvae reduce the yield by boring in the branches. In tests of sprays

for control of this Pyralid in 1958–59 and 1959–60, six applications at fortnightly intervals were made, beginning with the first signs of attack in mid-December, and it was found that 0·2 per cent. DDT and 0·25 per cent. trichlorphon (Dipterex) gave excellent protection, whereas 0·1 per cent. dieldrin greatly increased the proportion of branches attacked, possibly by killing some natural enemy of the Pyralid, though no parasites or predators were observed by day.

Coutinho (J. M.). **Lagarta rosada do algodão em São Paulo.** [The pink bollworm of cotton in São Paulo.]—*Biológico* **26** no. 10 pp. 199–205, 15 refs. São Paulo, 1960.

Pectinophora gossypiella (Saund.) is an important pest of cotton in São Paulo, but the extent of the damage caused was unknown. A survey was made in January–May 1960, flowers, buds and bolls from 12 localities being examined for larvae, and it was found that the infestation increased as the season advanced; it averaged more than 30 per cent. in May, at the end of it, when many of the larvae present appeared to be of the resting type. This indicated that the control measures in general use were insufficient. These included vacuum fumigation of seed for sowing with methyl bromide by the Mallet system, and inspection of fumigated seed showed that mortality of resting larvae, though good, was not complete. Other measures that can be adopted and are used in other countries are discussed.

Pigatti (A.) & Pereira jr. (J.). **Pesquisas sôbre alteração do gôsto da bebida de café colhido em plantas tratadas com BHC.** [Investigations on deterioration in the taste of coffee from plants treated with BHC.] —*Biológico* **26** no. 10 pp. 206–209, 5 refs. São Paulo, 1960. (With a summary in English.)

BHC dusts applied to coffee for the control of *Stephanoderes hampei* (Ferr.) have been stated not to affect the flavour of the beverage in São Paulo [*R.A.E.*, A **39** 296], but to do so in Nicaragua and Kenya [**41** 278–279]. In further tests in São Paulo, no tainting by BHC dusts could be detected, but the flavour varied with the ripeness of the berries.

Westdal (P. H.) & Barrett (C. F.). **Life-history and habits of the sunflower maggot, *Strauzia longipennis* (Wied.) (Diptera: Trypetidae), in Manitoba.**—*Canad. Ent.* **92** no. 7 pp. 481–488, 2 graphs, 16 refs. Ottawa, 1960.

The following is based on the authors' summary of this account of observations on *Strauzia longipennis* (Wied.) attacking sunflower (*Helianthus annuus*) in southern Manitoba [*cf. R.A.E.*, A **45** 344]. *S. longipennis*, all stages of which are described, is native to North America. It emerges in late June, and although male emergence reached a peak before female, the sex ratio was about 1 : 1. In the insectary, females mated several times before, during and after the oviposition period. Males survived for an average of 14·4 days, and females for 16·2. The preoviposition and oviposition periods averaged 6·7 and 8·3 days, and the females laid an average of 29·6 eggs each. The largest number laid by one female in 24 hours was 31, and peak oviposition occurred 8–10 days after emergence. The eggs are laid just beneath the epidermis of the stalk and hatch in about a week.

The larvae feed in the pith and pass through three instars. In the laboratory, these lasted 9·2, 7·8 and 18·1 days, respectively. In the field, larval development required about six weeks. When there are many larvae in one plant the pith may be completely consumed, and severe damage may be accompanied by secondary fungus infection. The plant remains healthy and vigorous in appearance even when the pith is completely destroyed. Varieties of sunflowers grown for oil production seldom break over, except in strong winds, and then usually only if also attacked by disease. The larvae leave the plants in late August or early September and enter the soil, where they pupate at a depth of about 1 in. The winter is passed in the pupal stage. *S. longipennis* was also taken on *H. maximilianii* and *H. tuberosus subcanescens* in the extreme south of Manitoba. The only parasite reared from it was tentatively determined as *Psilus atricornis* (Ashm.). Ants and spiders were observed to prey on caged adults.

Paul (L. C.) & Putnam (L. G.). **Morphometrics, parasites, and predators of migrant *Melanoplus bilituratus* (Wlk.) (Orthoptera: Acrididae) in Saskatchewan in 1940.**—*Canad. Ent.* **92** no. 7 pp. 488–493, 1 map, 4 refs. Ottawa, 1960.

The following is based almost entirely on the authors' summary of this account of observations on *Melanoplus bilituratus* (Wlk.) during an outbreak in south-western Saskatchewan in 1940. Comparative measurements of the lengths of the elytra and femora of migrant and residual grasshoppers from an area in which infestation had been so severe that crops were almost completely destroyed showed that the adults that migrated out of this district were more robust than those that remained. The elytra of grasshoppers collected from the invaded area were unusually long, and the E/F (elytron/femur) ratios of both migrant and residual grasshoppers were unusually large, exceeding those of nearly all collections and reported data available to the authors. These ratios were unusually close to that of *M. spretus* (Walsh) [*cf. R.A.E.*, A **37** 35; **48** 358], now apparently extinct, but the average wing lengths were considerably shorter. Migrant grasshoppers carried a lighter load of ectoparasitic red mites, tentatively determined as *Eutrombidium rostratum* (Scop.) (*trigonum* (Herm.)), than those that remained in the outbreak area. The percentages parasitised by Dipterous endoparasites were low and similar in the outbreak and invaded areas. Adults of parasitic and predacious Diptera were, however, much more abundant in the invaded areas than in the outbreak area. This, together with other supporting data, strongly suggests that these flies migrated with the grasshoppers.

Robinson (A. G.). **Effect of maleic hydrazide and other plant growth regulators on the pea aphid, *Acyrthosiphon pisum* (Harris), caged on broad bean, *Vicia faba* L.**—*Canad. Ent.* **92** no. 7 pp. 494–499, 1 graph, 7 refs. Ottawa, 1960.

The following is based mainly on the author's summary of this account of further investigations on the effect of plant-growth regulators on the mortality and fecundity of *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris) caged on seedlings of broad bean (*Vicia faba*) [*cf. R.A.E.*, A **48** 525]. In an experiment in which the lower double leaves were dipped in solutions for five seconds, the materials tested, with (in brackets) the concentrations, expressed as parts active ingredient per million, were amine of maleic hydrazide (2,000–40,000), amine of 2,4-D (2,4-dichlorophenoxyacetic acid)

(0·01–1,000), ester of 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) (0·001–0·1), amine of MCPA (2-methyl-4-chlorophenoxyacetic acid) (0·1–10), 2,4-DES (sodium 2,4-dichlorophenoxyethyl sulphate) (2,000–8,000), erbon (2-(2,4,5-trichlorophenoxy)ethyl 2,2-dichloropropionate) (100–10,000), carbyne (4-chlorobut-2-ynyl 3-chlorophenylcarbamate) (10–8,000) and potassium gibberellate (1–1,000); there was no appreciable adult or nymphal mortality or reduction in fecundity among aphids caged for five days on the next higher leaves of treated plants. In all tests in which maleic hydrazide was applied by root absorption for 48 hours [*loc. cit.*] at concentrations of 2,000–4,000 p.p.m. active ingredient, there was nymphal mortality and significant reductions in fecundity among aphids caged on the lower double leaves of the treated plants. On untreated plants, the average fecundity of the females was the same whether they were caged on the upper or lower surface of the leaf. The lower double leaves were as favourable as the next higher for adult survival and fecundity both on plants treated with maleic hydrazide and untreated plants. When adults were caged for five days on plants treated with maleic hydrazide and then transferred for five days to untreated plants, they continued to show reduced fecundity. When nymphs born and reared on plants treated with maleic hydrazide were transferred for their adult life to untreated plants, they also showed reduced fecundity. Adult aphids sprayed directly with maleic hydrazide at 4,000 p.p.m. and then caged for five days on untreated plants showed no mortality and no reduction in fecundity.

Turnock (W. J.). **Ecological life-history of the larch sawfly,** *Pristiphora erichsonii* **(Htg.) (Hymenoptera: Tenthredinidae), in Manitoba and Saskatchewan.**—*Canad. Ent.* **92** no. 7 pp. 500–516, 3 figs., 56 refs. Ottawa, 1960.

Information on the bionomics, seasonal history and ecology of *Pristiphora erichsonii* (Htg.) on larch in Manitoba and Saskatchewan is summarised from the results of investigations, some of which have already been noticed [*cf. R.A.E.*, A **37** 441; **44** 183; **45** 57, 176, 319; **48** 190, 526, etc.], and from the literature. *P. erichsonii* occurred in every larch stand examined in the two Provinces, where its principal food-plant is tamarack (*Larix laricina*). This tree, which is of value in initiating forest succession [*cf.* **37** 442], occurs typically in small stands on bogs, in which the ecoclimate is cool and moist and soil temperatures between autumn and spring rarely reach 20°C. [68°F.], but is also grown on the prairies, where the climate in plantations is relatively hot and dry. During the current outbreak [*cf.* **37** 441], populations have fluctuated widely between years and stands; few stands have been severely defoliated for more than three consecutive years [*cf.* **37** 442], and tree mortality has been insignificant.

The seasonal occurrence of *P. erichsonii* is variable, but in general pupae are present from mid-May to mid-July, adult emergence continues from late May until late July, eggs are present from about 10th June to mid-August and feeding larvae from mid-June to early September, and fifth-instar larvae begin to drop from the trees about 7th July. In the laboratory, adults emerged at temperatures between 5 and 20°C. [41 and 68°F.], with peak emergence at 10–15°C. [50–59°F.]; 15°C. appears to be the optimum for development and survival. In southern Saskatchewan, adults began to emerge on 17th July from cocoons buried in early May in a bog at a depth of 5 in., where the mean temperature was 6·1°C. [42·98°F.] and the maximum, reached on 15th June and 6th July, was 10°C. Oviposition occurred most commonly at 20°C. Adults were permanently harmed by

short exposures to 35°C. [95°F.] and were immobilised at temperatures lower than 0°C. [32°F.], though they survived exposure to −4°C. [24·8°F.] for 3·5 hours and to −12·5°C. [9·5°F.] for ten minutes. Up to 67 eggs may be laid in a single shoot, possibly the entire complement of a female, but normally each female oviposits in several shoots. The females are parthenogenetic and oviposit immediately after emergence, but, when no oviposition sites were available, oviposition was delayed for up to 19 days. The number of eggs per shoot increased with shoot length up to 70 mm., but few were laid on shoots less than 10 mm. in length. The number per cluster was 2–67; 87·7 per cent. of the clusters contained fewer than 31 eggs and over 40 per cent. contained 11–20. The depths at which cocoons were formed varied with the water-table [*cf.* **45** 176] and microtopography; below hummocks and in drained bogs they were as deep as 12 and 36 in., respectively. Exposure to 0°C. during the fortnight after cocoon formation increased the incidence of prolonged diapause. The temperature range and optimum temperature for successful overwintering were 0–15°C. and about 5°C.; mortality was high at −5°C. [23°F.]. After the initial hardening period in autumn, the eonymphs survived exposure to −10°C. [14°F.] for ten weeks. Of about 10,000 cocoons kept in south-eastern Manitoba, 0·05 per cent. gave rise to adults without diapause, but they emerged too late in the year to produce a second generation. The percentage of eonymphs that remained in diapause for over a year was 39–57 in Saskatchewan and 0–19 in Manitoba. The optimum temperature for pronymphal development was 5–15°C., and the estimated minimum temperature threshold for pupal development 2·8°C. [37·04°F.].

Of the environmental factors that affect populations, high soil temperatures in July may kill pupae and adults still in the cocoons; in Saskatchewan they cause little mortality—since temperatures exceed 20°C. only in the upper soil layer, from which the first adults emerge in spring, but early heat waves may be of importance in southern areas. The eggs hatched most successfully where the density of the trees exceeded 800 per acre and their height 30 ft. High water levels affect numbers directly, by drowning mature larvae dropping from the trees and larvae in cocoons in the soil, and indirectly by restricting shoot growth and foliage production. Only fifth-instar larvae are dislodged by storms from trees with foliage, and these die only when the ground is flooded. The most important biotic factor appears to be variation in the production of shoots and foliage [*cf.* **45** 319], which affects the numbers of eggs that can be laid and of larvae that can develop; the production of shoots and foliage is reduced by larval defoliation as well as by high water levels. No egg and few larval parasites have been reported [*cf.* **44** 183]. In Saskatchewan in 1951, 9–18 per cent. of the cocoons were entered by Elaterid larvae; three of the eight species present in bog soils are known to prey on *P. erichsonii*. The factors that initiate and terminate outbreaks over large areas are not known. There is no evidence that dispersion played any part during the current outbreak, and the existence of a small residual population responding to some generally favourable condition is indicated.

HARCOURT (D. G.). **Distribution of the immature stages of the diamondback moth, *Plutella maculipennis* (Curt.) (Lepidoptera: Plutellidae), on cabbage.**—*Canad. Ent.* **92** no. 7 pp. 517–521, 1 graph, 13 refs. Ottawa, 1960.

The following is almost entirely the author's summary. Counts of the immature stages of *Plutella maculipennis* (Curt.) on cabbage in Ontario did

not conform to the Poisson distribution, since there was an excess of uninfested plants over the expected number. Also, there was an excess of heavily infested plants. However, when the observed distributions were fitted to the negative binomial series $(q-p)^{-k}$, the chi-square test for goodness of fit indicated close agreement. The distributions of the various stages may be described as follows: egg $(q-p)^{-0.64}$, first instar $(q-p)^{-1.15}$, second instar $(q-p)^{-2.02}$, third instar $(q-p)^{-2.09}$, fourth instar $(q-p)^{-2.01}$, pupa $(q-p)^{-4}$. The increase in k from egg to first instar reflects egg mortality, and the increases from first to second instar and from mature larva to pupa the dispersal of larvae from crowded to less crowded plants. A comparison of the mean and variance of counts in each of 28 field plots showed that the variance was dependent upon the mean. When the counts were transformed to $\log (x+1)$ or $\log (x+k/2)$, independence was achieved.

Read (D. C.). **Mass rearing of the cabbage maggot,** *Hylemya brassicae* **(Bouché) (Diptera: Anthomyiidae) in the greenhouse.**—*Canad. Ent.* **92** no. 8 pp. 574–576, 1 fig., 2 refs. Ottawa, 1960.

In the method described, mass rearing of *Hylemyia brassicae* (Bch.) was carried out in galvanised iron cylinders each containing a 1-ft. layer of sifted sandy-loam soil on a 16-in. layer of washed coarse sand; the water-table was maintained at about 15 in. below the surface of the soil. About eight cylinders sufficed to rear some 10,000 larvae or pupae. Field-collected puparia are buried about 2 in. deep in the soil in one of three cylinders arranged with their tops projecting into a rearing cage similar to one described elsewhere [*R.A.E.*, A **43** 438], and a slice of swede is partly buried in the soil, so that about ½ in. projects, in each of the other two to provide oviposition sites for the emerging females. For rearing the larvae, the pieces of swede are transferred to a tray of sandy-loam soil with a moisture content of about 6 per cent. for 6–7 days, to destroy fungus growth, and are then placed on top of fresh slices in cylinders outside the cage. A fresh slice of swede is placed under each of the old ones every three days, and the old ones discarded as the larvae move down. Cubes of swede placed in the soil at a depth of about 7 in. and removed weekly prevent larvae that have entered the soil owing to lack of food from forming puparia prematurely. When required for use, immature larvae are obtained from the infested swede and mature larvae and puparia removed from the upper 8-in. layer of soil. If a second generation is required, cheesecloth cages are placed over the cylinders to retain the adults; insects for storage are obtained by sifting puparia from the soil and storing them at a temperature below 50°F. An estimated total of 5,000 progeny was reared per 100 females by this method. The soil in the cylinders was kept at 60–65°F., and the temperature of the rearing cage at 60–75°F.; the relative humidity in the cage was 40–60 per cent. Over 75 per cent. of the larvae pupated at a depth of 4–8 in., where the relative humidity of the soil was 15–20 per cent. Adult emergence ceased at about 70°F., and larvae and pupae reared at 60°F. gave rise to adults 20–40 days after pupation [*cf. loc. cit.*]. Development of a generation (adult to adult) required 40–50 days at 60–65°F. and about 75 days at 55°F.

Loschiavo (S. R.). **Life-history and behaviour of** *Trogoderma parabile* **Beal (Coleoptera: Dermestidae).**—*Canad. Ent.* **92** no. 8 pp. 611–618, 2 figs., 7 refs. Ottawa, 1960.

Trogoderma parabile Beal, which was described in 1954 and later reported to be a fairly common granary pest in California [*cf. R.A.E.*, A **49** 22], was

first recorded in Canada in 1957, when E. A. R. Liscombe found large numbers of all stages in flour mills and feed warehouses in southern Alberta; in 1958, A. R. Brooks reported it infesting feed mills and grain samples stored in small envelopes in Saskatchewan. Its bionomics were investigated, the food used being a mixture of finely ground wheat and bran, and the following is largely the author's summary of this account of the results. In the laboratory at 32°C. [89·6°F.] and 70 per cent. relative humidity, the egg stage lasted 6·9 and the pupal stage 4·1 days. The duration of the larval instars increased progressively from the second (4·7 days) to the sixth (7·4 days), and the total larval period lasted 34 days. The mean adult life span was 14·3 days, and the mean life-cycle 43·2. Each life stage was measured and is described. The greatest increase in size occurred between the third and fourth larval instars. Female pupae and adults were larger than their male counterparts. Single, mated females laid up to 94 eggs in one day, and 95 per cent. of the eggs were viable. A short preoviposition period preceded a period of maximum egg-production occurring in females 3–5 days old. Females older than seven days laid few eggs and lived for only a few days after the end of oviposition. Rate of mortality increased rapidly in females older than nine days. Daily disturbance of insects during development inhibited adult emergence but had no appreciable effect on rate of development. A high percentage of disturbed insects entered larval diapause. A one-week exposure at 10°C. [50°F.] prevented oviposition but did not affect the survival of young mated females. At 20°C. [68°F.], many eggs were laid, but none hatched. At 32°C., high egg-production was associated with high adult mortality, particularly among females. Although oviposition of young mated females was inhibited during a 5-day exposure at 10°C., maximum oviposition took place when the temperature was increased to 32°C. Mature larvae were not killed by a 6-day exposure at 20, 10 or −1°C. [30·2°F.].

Edwards (R. L.). **Relationship between grasshopper abundance and weather conditions in Saskatchewan, 1930–1958.**—*Canad. Ent.* **92** no. 8 pp. 619–624, 2 figs., 7 refs. Ottawa, 1960.

The following is almost entirely the author's summary. Records of populations of *Melanoplus bilituratus* (Wlk.), *M. bivittatus* (Say), *M. packardii* Scud. and *Camnula pellucida* (Scud.) in 19 areas of Saskatchewan during each of the past 25 years were compared with weather conditions in preceding years [*cf. R.A.E.*, A **46** 193]. Positive correlation with weighted mean monthly temperature during July–September for the previous three years was highly significant. Negative correlation with precipitation during April–August of the previous two years was significant in most areas.

Butcher (J. W.) & Haynes (D. L.). **Chemical control of the eastern spruce gall aphid with observations on host preference and population increase.** —*J. econ. Ent.* **53** no. 6 pp. 979–982, 1 graph, 5 refs. Menasha, Wis., 1960.

The following is based on the authors' introduction and abstract. In Michigan, *Chermes abietis* L. produces galls at the bases of new shoots of white spruce, *Picea glauca*, and Norway spruce, *P. abies* (*excelsa*), thus reducing their value as Christmas trees, and sprays were tested for its control on trees 4–6 ft. high in the field. These showed that 1 lb. lindane [almost pure γ BHC] per 100 U.S. gal. water gave good control when

applied after the last frost and before elongation of the terminal shoots began, whereas 2 lb. Sevin was less effective and 2 lb. dimethoate, 1 lb. malathion and 1 lb. mevinphos (Phosdrin) gave little or no control. Statistical analysis of infestations in 1958 and 1959 showed a 15 per cent. higher incidence of attack on white than on Norway spruce, a 6 per cent. increase in total infestation in the second year and a strong tendency for infestation to recur on previously infested trees. This suggests that disposing of infested trees before they became too numerous would reduce the infestation in a given planting and that it is unlikely that particular trees are resistant to attack. Even though previously uninfested trees appeared to be attacked at random each year, the rate of spread was so slow that one-fifth of the trees in the study area were expected to remain uninfested for five consecutive years, owing to insect behaviour alone.

Scriven (G. T.) & Fleschner (C. A.). **Insectary production of *Stethorus* species.**—*J. econ. Ent.* **53** no. 6 pp. 982–985, 5 figs., 2 refs. Menasha, Wis., 1960.

Stethorus spp. are widely distributed predators of Tetranychids and often control outbreaks. Although native species are usually present in mite-infested areas, it may be desirable to introduce others, and the mass production of imported species on *Tetranychus pacificus* McG. in the laboratory in California is described. Washed, waxed and graded oranges are kept in cold storage until needed, when they are arranged on hardware-cloth trays and transferred to a steam cabinet for "sweating" and then to a linting box, in which flocking lint is blown up through the tray on to the fruit. The lint is composed of viscose rayon fibres and provides a light fuzzy covering that encourages feeding and oviposition by the mites. That used for the permanent mite cultures contains 10 per cent. DDT to prevent contamination by predators and is coloured green. The mites are reared at 78–80°F., and successive trays of oranges are infested at weekly intervals by leaving them over the old, heavily infested trays for 4–5 days, after which the old trays are removed. Once in the week, a tray of oranges covered with white lint (not treated with DDT) is infested in the same way from each culture tray and used for rearing *Stethorus*, which is done in special cabinets at about 83°F. The adult Coccinellids are allowed to feed on the mites and oviposit for four days and are then removed, and the hatching larvae are provided with additional trays of mite-infested fruits. The newly emerged adults are attracted to a light and collected with an aspirator; if intended for field release, they are transferred to tubes and provided with honey as food.

Kerr (W. P.) & Brazzel (J. R.). **Laboratory tests of insecticides against eggs and larvae of the cabbage looper.**—*J. econ. Ent.* **53** no. 6 pp. 991–992, 6 refs. Menasha, Wis., 1960.

Trichoplusia ni (Hb.) has recently become a serious pest of cotton in the south-western United States and frequent applications of insecticides are sometimes needed for its control [*cf. R.A.E.*, A **47** 67, etc.]. In tests of 0·25–1 lb. mevinphos (Phosdrin), 0·25–0·75 lb. endrin, 0·5–2 lb. Sevin or Thiodan, 1–2 lb. DDT and 0·8–3 lb. of a mixture of toxaphene and DDT (2:1) in 7·5 U.S. gal. emulsion spray per acre, applied in a spray tower to day-old eggs on cotton tips, mevinphos gave 92 per cent. corrected mortality at 1 lb. per acre, and 2 lb. Sevin or DDT gave over 70 per cent.

and 0·5–1 lb. Sevin gave 50–60 per cent. control; the other materials were ineffective. When larvae were transferred to sprayed cotton tips, those in the first instar were relatively susceptible to all materials, but endrin and Thiodan were the most effective, giving complete mortality at 0·5–0·75 and 2 lb., respectively, and mevinphos and Sevin the least so. Larvae in the second and third instars were progressively less susceptible, but endrin and Thiodan continued to give the best control; none of the treatments was effective against a mixed population in the fourth and fifth instars, which indicates that control measures should be applied before the larvae reach the fourth instar.

Miller (B. S.), Robinson (R. J.), Johnson (J. A.), Jones (E. T.) & Ponnaiya (B. W. X.). **Studies on the relation between silica in wheat plants and resistance to Hessian fly attack.**—*J. econ. Ent.* **53** no. 6 pp. 995–999, 3 figs., 7 refs. Menasha, Wis., 1960.

The following is substantially the authors' abstract. The leaf sheaths of certain varieties of wheat and one variety of oats that are resistant to attack by *Mayetiola* (*Phytophaga*) *destructor* (Say) in the United States appear to have a much more complete and even distribution of silica deposits on their surface than do those of susceptible wheat varieties. The silica deposits on the latter are in the form of rod-shaped masses arranged in dispersed rows, with much space between. The density of the deposit depends on the age of the plant, and this factor should be considered in studying the problem of resistance. Four varieties of wheat were shown to have silicified hairs on the surface of the sheath, and most of these were susceptible to attack.

Gordon (H. T.) & Eldefrawi (M. E.). **Analog-synergism of several carbamate insecticides.**—*J. econ. Ent.* **53** no. 6 pp. 1004–1009, 16 refs. Menasha, Wis., 1960.

Dimetilan (3-methyl-5-pyrazolyl dimethylcarbamate) has been shown to be 20 times as toxic as Pyrolan or Sevin to *Musca domestica* L., though a much weaker inhibitor of fly-head cholinesterase *in vitro*.

In tests in which this compound, Isolan, Sevin and Pyrolan, alone and in pairs, were applied topically in acetone to females of a susceptible strain of *M. domestica*, it was the most toxic, followed by Isolan; it showed synergism with Sevin and Pyrolan, which were relatively non-toxic alone, but this was weak unless a quantity of Dimetilan sufficient to give considerable mortality alone was used. Isolan showed little synergism with Sevin and some antagonism with Pyrolan, and synergism was also shown by Sevin with Pyrolan. The condition for effective synergism among these analogues was apparently the combination of the LD50 of a moderately toxic, slowly detoxified analogue (the synergist) with an equivalent or somewhat lower dosage of a potentially much more toxic but rapidly detoxified one. Further synergism was shown when 0·2 μg. sesamex per insect was added to 1:1 mixtures of Dimetilan and Sevin [*cf. R.A.E.*, B **49** 102] but not at lower dosages.

In tests with the same materials, males of *Blattella germanica* (L.) showed similar reactions, though they were much less susceptible to the carbamates than was *M. domestica*. Isolan was the most effective and Sevin and Pyrolan non-toxic alone but moderately toxic when sesamex was added. Doses of Isolan or Dimetilan between the LD20 and LD50 were

strongly synergistic with either Sevin or Pyrolan, and a 1:1 mixture of Isolan and Sevin was further synergised by sesamex.

It is suggested that these species may possess a detoxifying " carbamate esterase " that destroys some carbamate insecticides, and that partial inhibition of this by Dimetilan, which is broken down slowly, accounts for the synergistic action of the latter with other carbamates that are broken down more easily.

The carbamates were not very toxic to nymphs of *Oncopeltus fasciatus* (Dall.). Sevin was more and Dimetilan less toxic than Isolan, and this showed good correlation with the anticholinesterase values obtained in tests on fly-brain cholinesterase, suggesting that there may be negligible carbamate-esterase activity in this bug. Pyrolan showed unexpectedly low toxicity, possibly owing to rapid hydrolysation by dilute alkalis or to slow penetration and diffusion in the insect as a result of low water-solubility. Synergism was of a very low order.

JOHANSEN (C.). **Bee repellent combined with dieldrin or Sevin in bee poisoning tests in alfalfa.**—*J. econ. Ent.* **53** no. 6 pp. 1010–1012, 1 fig., 5 refs. Menasha, Wis., 1960.

The following is based on the author's abstract. A bee repellent, R-874 (2-hydroxyethyl-n-octyl sulphide), provided good protection of bees against poisoning when added to sprays of dieldrin or Sevin in tests on flowering lucerne in Washington in 1959. Honey bees and bumble bees (*Bombus* spp.) were repelled effectively for 6–8 days when the average maximum temperature for the week after application was 71°F. and for 3–4 days when it was 87°F.

JOHANSEN (C.). **Bee poisoning versus clover aphid control in red clover grown for seed.**—*J. econ. Ent.* **53** no. 6 pp. 1012–1015, 5 refs. Menasha, Wis., 1960.

Anuraphis bakeri (Cowen) was the most destructive insect attacking red clover [*Trifolium pratense*] grown for seed in eastern Washington in 1956–59, causing reductions in the weight of individual seeds and in the numbers of seeds produced. In tests of 20 chemical treatments in 1958–59, consideration of aphid control and lack of injury to honey bees, predators, of which *Hippodamia convergens* (Guer.), *Orius tristicolor* (White), *Geocoris pallens* Stål, *Lasiophthicus* (*Scaeva*) *pyrastri* (L.), *Chrysopa plorabunda* Fitch and *Nabis alternatus* Parshley were most prevalent, and parasites (*Aphelinus lapisligni* How.) indicated that 1 lb. Trithion or phosphamidon and 1 lb. of a 1:1 mixture of Methyl Trithion (O,O-dimethyl S-p-chlorophenylthiomethyl phosphorodithioate) and Trithion in 24–25 U.S. gal. emulsion sprays per acre and 2 lb. phorate per acre in granules were the most effective and that they should be applied about 4–5 weeks after cutting to give the best results.

KUWAYAMA (S.), SAKURAI (K.) & ENDO (K.). **Soil insects in Hokkaido, Japan, with special reference to the effects of some chlorinated hydrocarbons.**—*J. econ. Ent.* **53** no. 6 pp. 1015–1018, 9 refs. Menasha, Wis., 1960.

Species of *Hylemyia* are among the more important soil insects in Hokkaido, Japan [*cf. R.A.E.*, A **47** 320]. *H. cilicrura* (Rond.) has injured

kidney beans, soy beans, Adzuki beans [*Phaseolus angularis*], melon, asparagus, cereals and other crops since about 1917. Tests on the protection of kidney beans in 1955–58 showed that chlorinated hydrocarbons were less effective when used to coat the seeds than when mixed with soil in the furrow or with the fertiliser, and that aldrin, dieldrin and heptachlor were effective and not phytotoxic, but BHC less satisfactory. Heptachlor and aldrin dusts gave protection for more than 100 days, and heptachlor proved almost as good in 15 per cent. granules as in 2·5 per cent. dust. *H. antiqua* (Mg.), which was first observed in 1938 and has since spread throughout Hokkaido, attacking onion and Welsh onion [*Allium fistulosum*], was controlled in 1952 by BHC, and since by dusts of aldrin or heptachlor, mixed with the soil in the furrows at 2·14 and 1·34 lb. per acre, respectively, on onion and at 1·07 lb. on Welsh onion. *H. floralis* (Fall.) damages radishes, swedes, cabbages, turnip and other crucifers, and *H. pilipyga* (Villen.) has been found attacking the same plants. Dusts of aldrin or heptachlor, at 2·14 and 1·34 lb. per acre, respectively, applied in the furrow at a depth of 2 in., gave good control.

Cutworms attack many crops. *Agrotis segetum* (Schiff.) (*fucosa* Btlr.), *A. ypsilon* (Hfn.), *A. informis* Leech and *Amathes c-nigrum* (L.) are common and injurious, but the first can be controlled by mixing 0·89 lb. heptachlor or 1·07 lb. aldrin per acre into the soil just before sowing or transplanting. Wireworms, of which *Agriotes fuscicollis* Miwa is followed in importance by *Melanotus caudex* Lewis and *Ctenicera puncticollis* (Motsch.), damage a wide variety of crops, particularly cereals and potato, but have been controlled by BHC, aldrin and heptachlor; these are applied to grain crops by seed treatment, and to potato by broadcasting them over the field just before planting. *Gryllotalpa africana* P. de B. damages cereals and has recently injured potatoes. For control, broadcasting 27–45 lb. 4 per cent. aldrin or 2·5 per cent. heptachlor dust per acre and working it into the top 4 in. of soil just before planting, in May, is recommended.

Injury to the underground parts of almost all upland crops by the larvae of *Mimela testaceipes* (Motsch.), *Anomala lucens* Ballion and *A. rufocuprea* Motsch. was formerly considerable [*cf.* **25** 672], but has been less severe for the past ten years.

Huddleston (E. W.), Gyrisco (G. G.) & Lisk (D. J.). **DDT residues on New York dairy farms following the gypsy moth eradication program.**—*J. econ. Ent.* **53** no. 6 pp. 1019–1021, 2 refs. Menasha, Wis., 1960.

In view of a plan to eradicate *Lymantria* (*Porthetria*) *dispar* (L.) from a large area of New York State by aerial spraying of all trees and shrubs in it with DDT at 1 lb. in 1 U.S. gal. mixed oil solvents per acre, the residues likely to be left by such treatment on dairy farms were investigated in 1957. There was little or no loss of deposit after seven days of heavy rain from applications in March or April on meadow grass, but considerable apparent reductions after 49–97 days, owing to the growth of the grass. Similar results were obtained after actual eradication sprays in September, and the examination of samples from farms in the treated area showed contamination of milk with DDT for at least a year and of eggs for a month. It is concluded that DDT is an unsuitable insecticide to use for the eradication of *L. dispar* in dairy-farming areas.

David (W. A. L.), Metcalf (R. L.) & Winton (M.). **The systemic insecticidal properties of certain carbamates.**—*J. econ. Ent.* **53** no. 6 pp. 1021–1025, 9 refs. Menasha, Wis., 1960.

When Isolan, Sevin and seven substituted phenyl N-methylcarbamates were applied in solution to lima-bean leaves and newly hatched larvae of *Estigmene acraea* (Dru.) were caged on them immediately, Sevin was extremely toxic, but less so than m-tert.-butylphenyl N-methylcarbamate; the m-isopropylphenyl, m-dimethylaminophenyl and m-ethoxyphenyl compounds were less toxic, but equal among themselves, and better than Isolan or o-ethoxyphenyl N-methylcarbamate, and the m-n-butoxy- and m-sec.-butoxyphenyl compounds gave no kill and scorched the leaves. When the roots were put in solutions of the compounds and larvae were caged on leaves cut one or three days later, there was no difference in mortality for the two periods and Sevin was less effective than the m-isopropyl and m-tert.-butyl compounds, which gave very good results in spite of the extremely low solubility of the latter, and more so than Isolan and the o-ethoxy compound; these were followed by the m-ethoxy- and m-dimethylaminophenyl N-methylcarbamates, and the other two were ineffective; only the three most effective compounds failed to cause plant injury. The carbamates showed the same order of effectiveness when applied in solutions or fine suspensions to the soil in which the plants were growing, but when they were applied to older leaves, none affected larvae feeding on the young untreated foliage. Anticholinesterase assay of extracts of different parts of plants that had absorbed m-isopropylphenyl N-methylcarbamate through the roots showed that the highest concentrations accumulated in the leaves, where decomposition was comparatively rapid, and that there was no selective absorption or rejection by the roots.

Stephen (W. P.). **Artificial bee beds for the propagation of the alkali bee, *Nomia melanderi*.**—*J. econ. Ent.* **53** no. 6 pp. 1025–1030, 7 figs., 5 refs. Menasha, Wis., 1960.

The following is substantially the author's abstract. The construction of artificial beds for the propagation of *Nomia melanderi* Ckll., which is the principal pollinator of lucerne in parts of the western United States [*cf. R.A.E.*, A **46** 348], was achieved in Oregon by reproducing the texture, moisture and alkalinity of the native soils in which the bee was found [*cf.* **49** 303]. Pits up to 60 ft. square were excavated near lucerne fields to a depth of 3 ft. and lined with polyethylene, 2–4 in. of gravel was added and the pits were filled with soil containing less than 7 per cent. clay-size particles. Salt was incorporated into the upper layer of the bed to effect soil dispersion and reduce loss of water, tubes were led through the soil to the gravel layer as a method of introducing the necessary moisture, and soil containing inhabited burrows was transferred from existing breeding sites into the bed to serve as the nucleus of the new colony. Burrowing populations of more than 250 individuals per sq. ft. were recorded after two years, which is eight times the density in the best natural site in Oregon.

Norris jr. (D. M.). **Systemic insecticidal action in the cortical tissues of elm twigs.**—*J. econ. Ent.* **53** no. 6 pp. 1034–1036, 3 refs. Menasha, Wis., 1960.

In further investigations on the use of systemic insecticides for the control of adults of *Scolytus multistriatus* (Marsham), which transmit *Ceratocystis ulmi*, on elm [*cf. R.A.E.*, A **49** 29], assays made by measuring the length of feeding niches and determining the mortality of beetles exposed to twigs from treated trees showed that Shell 3562 (dimethyl 1-dimethylcarbamoyl-1-propen-2-yl phosphate) and phosphamidon were effectively localised in the

cortical twig tissues after trunk implantation [*cf.* **48** 118], the former preventing feeding niches from exceeding 3 mm. [*cf.* **49** 29] for 15 and 29 days after application at dosages of 6 and 18 g. per tree, respectively. Di-Syston (O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate), demeton, phorate and dimethoate gave less satisfactory results, and it is concluded that effectiveness requires high solubility in water, the presence of a phosphate or phosphorothiolate rather than a phosphorothionate or phosphorodithioate structure, or both.

Smith (R. H.). **Resistance of pines to the pine reproduction weevil,** *Cylindrocopturus eatoni*.—*J. econ. Ent.* **53** no. 6 pp. 1044–1048, 2 figs., 7 refs. Menasha, Wis., 1960.

The following is based on the author's abstract. *Cylindrocopturus eatoni* Buch. causes serious losses in young plantations of Jeffrey pine (*Pinus jeffreyi*) and ponderosa pine (*P. ponderosa*) in many parts of California [*cf. R.A.E.*, A **30** 523]. Crossing *P. jeffreyi* with Coulter pine (*P. coulteri*) produces resistant progeny [*cf.* **49** 550], and a three-way hybrid of these two and *P. ponderosa* is also resistant. The mode of action of resistance is not known, though non-preference, antibiosis and tolerance are all indicated. Variation in resistance to the weevil within a species appears to be heritable, and resistance within a species and between species may be imparted by either parent, though there are indications that it may be more attributable to the female parent. The progeny from self-pollinated plants is less resistant than that from cross pollination. Many pine species and hybrids have been classified as resistant or non-resistant from the results of forced attacks and natural infestations. A large-scale pollination project is under way to produce resistant pines for planting in California.

Parencia jr. (C. R.), Cowan jr. (C. B.) & Davis (J. W.). **Control of several early-season cotton pests with insecticides.**—*J. econ. Ent.* **53** no. 6 pp. 1051–1054, 4 refs. Menasha, Wis., 1960.

Psallus seriatus (Reut.), overwintered adults of *Anthonomus grandis* Boh. and *Frankliniella* sp. were the only important pests of cotton early in the season in central Texas in 1959. In sprays applied in May–June, a mixture of 1·5 lb. toxaphene and 0·75 lb. DDT per acre, and 0·25 lb. azinphos-methyl (Guthion) or 0·5 lb. methyl-parathion per acre, gave much better control of *A. grandis* in field cages than did 0·25 lb. dieldrin or 2·25 lb. toxaphene alone, and similar results were obtained with *A. grandis* and *P. seriatus* in field plots; Strobane was effective with DDT but ineffective alone against all three species, and toxaphene alone was moderately effective against the thrips. Sevin at 1 lb. 85 per cent. wettable powder per acre controlled all three, but rain a short time after application reduced its effectiveness, and Shell SD-3562 (dimethyl 1-dimethylcarbamoyl-1-propen-2-yl phosphate) at 0·5 lb. and Shell SD-4402 (1,3,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanophthalan), Bayer 25141 (O,O-diethyl O-p-methylsulphinylphenyl phosphorothioate) and dimethoate at 0·25 lb. resembled dieldrin in effect.

Later in the season, DDT was added to the sprays of dieldrin, azinphos-methyl and methyl-parathion, and other compounds were applied at higher rates; all but SD-3562 caused significant increases in the yield of seed cotton when applied 5–8 times in July–August. In a plot in which *Heliothis zea* (Boddie) became important, dieldrin or toxaphene with DDT, Sevin, and SD-4402 gave significantly better control than SD-3562 or Bayer 25141.

Bartlett (B. R.) & Lagace (C. F.). **Interference with the biological control of cottony-cushion scale by insecticides and attempts to re-establish a favorable natural balance.**—*J. econ. Ent.* **53** no. 6 pp. 1055–1058, 12 refs. Menasha, Wis., 1960.

Icerya purchasi Mask., which had been of little importance in the Coachella and Imperial desert valleys of California since the introduction of *Rodolia cardinalis* (Muls.) against it in 1888–89, became increasingly injurious on *Citrus* after 1950, and relatively high doses of malathion and parathion are now recommended for use in sprays against it.

A survey of areas of reported outbreaks in the two valleys and of similar areas of infestation in Arizona was begun in 1956. This showed that *R. cardinalis* was the only natural enemy of the mealybug present. Under normal conditions, it almost disappears from *Citrus* from late November to late February or March, while the Coccid continues to develop slowly, but becomes active with warmer weather and usually destroys all visible stages by late May or June. Eggs that remain produce a light mealybug infestation in the following autumn and winter, and the cycle is repeated until the infestation reaches a stable sub-economic level. When *Rodolia* is eliminated by long cold winters, the introduction of 20 adults, including 10 mated females, into an infested grove in spring is sufficient to afford control in 2–3 months. Interference with biological control was found to be due to the drift of insecticides from other crops, particularly of malathion, parathion or DDT applied by aeroplane; malathion was more harmful than parathion, since the latter killed small scales as well as the predators. Aerial applications of dusts caused most destruction of *Rodolia*, and drift from repeated treatments in April–June were most often responsible for serious scale outbreaks.

Prevention of drift by paying attention to the direction of the wind, by using ground equipment where possible and by spraying rather than dusting largely eliminated the occurrence of *Icerya* outbreaks. It was found that laboratory propagation of *R. cardinalis* was impracticable, but that field-collected pupae and adults could be stored for long periods at low temperature. Periodical release of *Cryptochetum iceryae* (Will.) would probably give satisfactory winter control, but is considered impracticable because this parasite is difficult to establish and would probably be killed by high temperatures each year. Attempts to introduce a species of *Syneura*, possibly *S. cocciphila* Coq., from Mexico and two other species of *Rodolia* from Southern Rhodesia and South Africa were unsuccessful.

DePew (L. J.). **Control of *Oligonychus pratensis* attacking winter wheat in western Kansas.**—*J. econ. Ent.* **53** no. 6 pp. 1061–1063, 1 fig., 8 refs. Menasha, Wis., 1960.

In recent years in western Kansas, wheat plants heavily infested by *Oligonychus pratensis* (Banks) have been killed by a combination of mite feeding and lack of sufficient soil moisture. In preliminary tests of acaricides applied to winter wheat in 17 U.S. gal. spray per acre on 30th October 1958, 0·375 lb. demeton or azinphos-methyl (Guthion), 0·5 lb. Trithion, parathion or Kelthane and 1 lb. malathion in emulsion sprays and 0·5 lb. Tedion in a wettable-powder spray reduced populations significantly after three days but were unsatisfactory after 14. Similar applications of demeton, Trithion, 0·75 lb. parathion, Kelthane or Phostex (a mixture of bis(dialkyloxyphosphinothioyl)disulphides) and 1 lb. Delnav [2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)] on 24th April 1959 caused significant reductions after

four days, with Trithion and Kelthane still effective after 14. When applied by aircraft in 2 U.S. gal. diesel oil per acre on 26th May 1959, 0·5–1 lb. parathion caused significant reductions in mite populations after 3 and 14 days and significant increases in seed yield.

Ridgway (R. L.) & Gyrisco (G. G.). **Studies of the biology of the tarnished plant bug,** *Lygus lineolaris*.—*J. econ. Ent.* **53** no. 6 pp. 1063–1065, 2 graphs, 6 refs. Menasha, Wis., 1960.

The following is substantially the authors' abstract. As *Lygus lineolaris* (P. de B.) is an important pest of the seed of birdsfoot trefoil (*Lotus corniculatus*), its bionomics were studied in New York in 1958–59. Weekly collection of bugs and dissection of the females for observation of egg development indicated that there were at least two and probably three generations a year on the crop. Flight measurements showed that 90 per cent. of the insects fly within 6 ft. of the ground and few, if any, higher than 18 ft. Males outnumbered females over the whole growing season, but females significantly outnumbered males among examples collected from adhesive traps in spring, before the appearance of the first new adults of the year.

Lindgren (D. L.) & Vincent (L. E.). **The relation of moisture content and temperature of stored grain to the effectiveness of grain fumigants under forced circulation.**—*J. econ. Ent.* **53** no. 6 pp. 1071–1077, 12 graphs, 5 refs. Menasha, Wis., 1960.

The following is based on the authors' abstract. When carbon tetrachloride, hydrogen cyanide and methyl bromide were applied as fumigants under forced circulation for five hours at temperatures of 50, 70 and 90°F. with no load and in the presence of wheat and maize containing 10, 12·5 or 15 per cent. moisture, the drop in concentration was greater in maize [*cf. R.A.E.*, A **49** 65] than in wheat and also at the higher moisture contents of either grain, and these effects were reflected in the mortality of adults of *Sitophilus oryzae* (L.) and *Tribolium confusum* Duv. inserted in probes into the grain. The sorption of carbon tetrachloride was greatest at 50 and least at 90°, but temperature caused little variation in the sorption of HCN or methyl bromide. *S. oryzae* was less susceptible than *T. confusum* to carbon tetrachloride and HCN and more so to methyl bromide, and both were more susceptible to all three fumigants at the higher temperatures.

Huddleston (E. W.) & others. **Sampling experimental plots of alfalfa for insecticide residues.**—*J. econ. Ent.* **53** no. 6 pp. 1078–1080, 4 refs. Menasha, Wis., 1960.

Details are given of experiments with a sampling method utilising both a stratified-random and a systematic sampling procedure, to determine the optimum number of samples and the optimum plot size for estimating insecticide residues on lucerne. It is concluded that chemical analysis of one sample, consisting of 20 subsamples, each obtained by cutting and mixing the lucerne from an area of 1–2 sq ft. and taking one twentieth of the desired sample weight (500 g.) from it, gives optimum results and that a plot size of 20 ft. × 40 ft. is suitable.

Menn (J. J.), Patchett (G. G.) & Batchelder (G. H.). **The persistence of Trithion, an organophosphorus insecticide, in soil.**—*J. econ. Ent.* **53** no. 6 pp. 1080–1082, 1 graph, 7 refs. Menasha, Wis., 1960.

In tests of the persistence of Trithion in three types of Californian soils, 5 per cent. granules were thoroughly mixed with Sorrento loam, Yolo silty clay loam and Santa Cruz loamy sand to give 10 parts technical compound per million, and the samples were kept at room temperature in contact with air, at a moisture level of about 10 per cent. Residues in soil extracts taken after 33, 78 and 180 days were determined by the cholinesterase-inhibition method [*R.A.E.*, A **49** 48], and it was calculated that 50 per cent. degradation occurred in 200, 100 and 170 days in the three soils, respectively. Soil pH had no apparent effect, but high contents of either clay or organic matter appeared to contribute to degradation. Persistence increased significantly in autoclaved Santa Cruz sand and in Sorrento soil that was fumigated before treatment, apparently owing to partial destruction of soil micro-organisms.

Madsen (H. F.) & Falcon (L. A.). **DDT-resistant codling moths on pears in California.**—*J. econ. Ent.* **53** no. 6 pp. 1083–1085, 4 refs. Menasha, Wis., 1960.

The following is based largely on the authors' abstract. Poor control of *Cydia* (*Carpocapsa*) *pomonella* (L.) with DDT was reported from pear orchards in Sacramento and Solano Counties in California in 1958 [*cf.* also *R.A.E.*, A **48** 31], and tests in three of them in 1959 showed no control from well-timed sprays of 2 lb. 50 per cent. wettable DDT per 100 U.S. gal. and no improvement when this amount of DDT was added to sprays of 1 lb. 25 per cent. wettable parathion per 100 U.S. gal., indicating that resistance to DDT had developed. Treatment with 1·5 lb. 25 per cent. wettable azinphos-methyl (Guthion) or azinphos-ethyl (Ethyl Guthion) per 100 U.S. gal. gave excellent control, and halving the dosage resulted in a significant increase in larval entries for the ethyl but not for the methyl compound; azinphos-methyl was less effective in an emulsion spray. Sevin gave good control at 1·5 lb. 50 per cent. wettable powder per 100 U.S. gal. in all tests, but Kepone [2,3,3a,4,5,6,7,7a,8,8-decachloro-3a,4,7,7a-tetrahydro-4,7-methano-indene-1-one] and Trithion did not give commercial control, and diazinon was effective when used at intervals of a fortnight, but did not compare satisfactorily with Sevin and azinphos-methyl in a standard schedule timed by bait-pan catches.

Anthon (E. W.). **Insecticidal control of San Jose scale on stone fruits.**—*J. econ. Ent.* **53** no. 6 pp. 1085–1087, 2 refs. Menasha, Wis., 1960.

Since parathion, applied to stone-fruit trees in the delayed-dormant stage, has given less adequate control of *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.) in recent years than formerly, other sprays were tested on cherry and prune in Washington State in 1957–59. Quantities given are per 100 U.S. gal. water. Very good control was obtained with an emulsion of the new Volck Supreme oil (93 per cent. unsulphonated residue, gravity 30·6 API, viscosity 142 SSU at 100°F.) at 2 U.S. gal. alone or at 1 U.S. gal. with either 1 U.S. pint 45 per cent. Trithion, 1 lb. 25 per cent. wettable parathion or 2 lb. 25 per cent. malathion or diazinon; 2 U.S. gal. 95 per cent. dormant oil emulsion containing 2·2 per cent. ethion also gave good control; 50 per cent. wettable Sevin was not satisfactory alone at 2 lb.,

but gave good control at 1 lb. when combined with 1 U.S. gal. Volck oil, and 1·5 U.S. pint 17·5 per cent. azinphos-methyl (Guthion) or 1 U.S. pint 46 per cent. dimethoate with 1 U.S. gal. Volck oil was less effective. When used alone, Volck oil did not give satisfactory control at 1 U.S. gal. and was not adequate for good control of a heavy infestation at 1·5 U.S. gal. It caused less injury to the trees than dormant oil, possibly because it was used at lower concentrations.

Harrison (F. P.). **Corn earworm oviposition and the effect of DDT on the egg predator complex in corn silk.**—*J. econ. Ent.* **53** no. 6 pp. 1088–1094, 9 figs., 10 refs. Menasha, Wis., 1960.

The following is based on the author's abstract. Observations on sweet maize sown on 15th and 25th May, 4th and 14th June and 24th July 1959 in Maryland showed that oviposition on the silks by *Heliothis zea* (Boddie) was relatively light on the first three sowings, but increased considerably on the last two; such an increase in activity is usually observed late in the season. Newly emerged silks were the most attractive, but oviposition was also observed on silks more than ten days old. The main predators of the eggs were *Orius insidiosus* (Say), *Ceratomegilla* (*Coleomegilla*) *maculata* (Deg.) and *Chrysopa oculata* Say; others were also present, but in very limited numbers. There was not a very close correlation between the number of *Heliothis* eggs and the number of predators, particularly in the case of *Orius*, but when predator populations were reduced by spraying with DDT in oil emulsion, there was lower mortality of *Heliothis* eggs.

Barnes (O. L.). **Establishment of imported parasites of the spotted alfalfa aphid in Arizona.**—*J. econ. Ent.* **53** no. 6 pp. 1094–1096, 6 refs. Menasha, Wis., 1960.

The following is based on the author's abstract. About 235,000 pupae and adults of *Aphelinus semiflavus* How., *Praon palitans* Mues. and *Trioxys utilis* Mues. were shipped from laboratories in New Jersey and California to Arizona between November 1955 and July 1957 for release in lucerne fields against *Therioaphis maculata* (Buckt.). Releases were made at several sites, the numbers liberated at a single site ranging from 250 to over 56,000. *A. semiflavus* was recovered in small numbers at several places in central Arizona, the last time being in April 1959 about 100 miles north of the nearest release site. *P. palitans* was recovered several times in central and south-western Arizona; in 1959, it was collected from five places in the south-central and two in the north-central part of the State, but was of no consequence in controlling the aphid. *Trioxys* became generally established in the lucerne-growing districts of southern Arizona and is an important factor in controlling the aphid.

Breakey (E. P.). **The blackheaded fireworm of cranberry—a pest of the evergreen huckleberry in western Washington.**—*J. econ. Ent.* **53** no. 6 pp. 1097–1099, 7 refs. Menasha, Wis., 1960.

Moths reared from larvae proving destructive to the terminal growth of the young shoots of *Vaccinium ovatum*, an important decorative evergreen and source of fruit, on the Olympic Peninsula of western Washington in 1958 and 1959 were identified by Gates Clarke as *Rhopobota naevana* (Hb.), which

had previously been known in America only from cranberry. Spraying with 2 lb. 50 per cent. wettable DDD (TDE) per 100 U.S. gal. in mid-April, as soon as new growth of the plant began, resulted in very small numbers of injured tips on 8th June, as compared with unsprayed plants. Small larvae were found in May 1959 and apparently became full-fed in mid-June; caged larvae gave rise to adults on 1st–15th July. A few eggs were laid on the lower surface of leaves near the ground in July. Parasites reared from caged larvae comprised one example of a species of *Eulasiona* and 12 of a species of *Angitia* (*Horogenes*). They killed about 10 per cent. of the larvae during the last instar. The synonymy of *R. naevana* [*cf. R.A.E.*, A **17** 309] is discussed.

Dominick (C. B.). **Experiments for early-season control of the green peach aphid on tobacco.**—*J. econ. Ent.* **53** no. 6 pp. 1099–1101, 4 refs. Menasha, Wis., 1960.

In Virginia, *Myzus persicae* (Sulz.) is most injurious to tobacco when it becomes established early in the growing season and reaches destructive numbers before it is checked by unfavourable weather, biotic agents or artificial control measures. Flue-cured tobacco is treated with parathion or malathion but usually not until late in the season, when the infestation attracts attention, but at this time, coverage is difficult to attain and most of the damage may already have occurred. Systemic insecticides, applied before or at transplanting, were tested in 1956–59. Phorate and demeton in the transplant water gave excellent control for about six weeks, but phorate in a plant-bed drench or a foliage spray after transplanting gave poor results. Dimethoate and Am. Cyanamid 18706 (O,O-dimethyl S-ethylcarbamoylmethyl phosphorodithioate) in the transplant water were less promising than phorate, and as the margin of plant safety of the four systemic insecticides in transplant water is rather limited, their use is not recommended. In preventive treatments, applied to the foliage twice in June, 0·375 lb. azinphos-methyl (Guthion) or Thiodan and 0·3 lb. endrin or Shell SD-4402 (1,3,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanophthalan) per 50 U.S. gal. emulsion spray considerably reduced aphid increase, whereas trichlorphon (Dipterex), DDD (TDE), Sevin and Kepone [2,3,3a,4,5,6,7,7a,8,8-decachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene-1-one] gave relatively poor results. In dusts, 4 per cent. Thiodan, 2·5–3 per cent. azinphos-methyl and 2 per cent. endrin gave good control, but Sevin, DDD and trichlorphon permitted moderate increase of the aphid.

Davis (A. C.). *Drosophila* **control in tomato fields.**—*J. econ. Ent.* **53** no. 6 pp. 1107–1110, 9 refs. Menasha, Wis., 1960.

In field-plot tests in New York in 1955, various insecticides were applied in 120 U.S. gal. spray per acre, nine times at weekly intervals from 9th August, to prevent oviposition in tomato fruits by *Drosophila*, mainly *D. melanogaster* Mg., and contamination of the canned product; yeast hydrolysate was added as an attractant in the first six applications. Similar tests with the insecticides in 46 U.S. gal. spray per acre or in granules were made in 1957. The results indicated that 0·5 lb. diazinon per acre satisfactorily reduced *Drosophila* activity in the fields for at least 3–5 days, whether applied in a suspension or emulsion spray or granular formulation; the granules showed the longest residual action, and repeated applications appeared to have a cumulative effect. Malathion at 0·5–1 lb. in sprays was

effective for only 2–3 days, after which *Drosophila* activity increased rapidly, in both field plots and commercial plantings, and sprays of 0·25 lb. mevinphos (Phosdrin) also showed a relatively transient effect. Fenchlorphos (ronnel), in sprays and granules, and Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate) in sprays, at 1 lb. per acre, tested only in 1957, compared favourably with diazinon. Tomatos treated with the yeast hydrolysate did not attract more flies than untreated ones.

Tomatos in the field were apparently susceptible to attack by *Drosophila* from the third week in August to late September, and a maximum of four weekly applications of insecticide is probably necessary for their protection.

Tomlinson jr. (W. E.). **Control of the cranberry fruitworm,** *Acrobasis vaccinii*.—*J. econ. Ent.* **53** no. 6 pp. 1116–1119, 1 fig., 6 refs. Menasha, Wis., 1960.

Insecticides were compared for the control of *Acrobasis* (*Mineola*) *vaccinii* Ril. on cranberry in Massachusetts in 1953–59. When applied in 300 U.S. gal. spray per acre as soon as there were four or more unhatched unparasitised eggs per 100 berries and again ten days later, 0·75 lb. flowable and 0·9 lb. wettable parathion, 1·5 lb. wettable azinphos-methyl (Guthion), 1·875 lb. wettable malathion, 2·25 lb. emulsifiable malathion or wettable diazinon or Thiodan, 3 lb. wettable Sevin and 12 lb. rotenone all gave averages of more than 90 per cent. control in at least two years of testing, whereas cryolite gave erratic results. In single tests, 3 lb. Delnav (2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)) or Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate) and 0·6 lb. endrin in emulsion sprays and 1·5 lb. flowable Trithion also gave more than 90 per cent. control.

In 25 U.S. gal. semi-concentrated spray per acre, 1 lb. flowable parathion or Trithion was very effective, 1 lb. diazinon or methyl-parathion less so and 2·25 lb. malathion ineffective. All the phosphorus compounds showed ovicidal action, and 0·5 lb. parathion, mevinphos (phosdrin), phosphamidon or dimethoate killed significant numbers of larvae feeding in the fruits when applied in 5–8 U.S. gal. spray per acre, but were less effective at lower concentrations.

Shorey (H. H.) & Anderson (L. D.). **Biology and control of the morning-glory leaf miner,** *Bedellia somnulentella*, **on sweet potatoes.**—*J. econ. Ent.* **53** no. 6 pp. 1119–1122, 3 figs., 4 refs. Menasha, Wis., 1960.

Larvae of *Bedellia somnulentella* (Zell.), which is not normally a crop pest, caused extensive damage to the foliage of sweet potato in San Diego County, California, in 1959. The eggs were laid on the leaves, mainly near the veins on the lower surface; larvae in the first two instars formed serpentine mines in the leaves and those in the other three made blotch mines, each larva constructing and abandoning several of these during the course of its development, and many larvae were present in each leaf where populations were heavy. Naturally occurring populations of larvae were heavily parasitised by *Apanteles bedelliae* Vier. The full-fed larva spun numerous threads below the mined area of the leaf, and the naked pupa was fastened to these and supported by them. The egg, larval and pupal stages lasted about 4·5, 11 and 4·5 days, respectively, at 80°F. Development continued on wild food-plants in the coastal area during the winter of 1959–60.

In tests on control, 4·3 lb. toxaphene, 0·8 lb. diazinon, 0·7 lb. DDT, 0·6 lb.

trichlorphon (Dylox) and 0·2 lb. parathion or malathion, applied in about 50 U.S. gal. spray per acre on 27th July or 14th August, gave good initial control, but all plots rapidly became reinfested, whereas treatment of a 3-acre field with 1 lb. diazinon per acre in a 2 per cent. dust gave practically complete control with no substantial reinfestation for the rest of the growing season.

Miskimen (G. W.). **Comparison of Sevin with DDT and rotenone on tomatoes under tropical conditions.**—*J. econ. Ent.* **53** no. 6 pp. 1128–1129, 4 refs. Menasha, Wis., 1960.

The growing of tomato and other vegetable crops in the U.S. Virgin Islands is severely restricted by insect pests, and rotenone, DDT and chlordane have not given effective control. Observations on St. Croix in 1959 showed that tomatos, which are potentially a valuable export crop, were attacked mainly by *Protoparce sexta* (Joh.), *Erinnyis ello* (L.), *Prodenia ornithogalli* Gn., *P. latifascia* Wlk., *Agromyza* sp., *Nezara viridula* (L.) and *Phthia picta* (Dru.), and Sevin was compared with DDT and rotenone, both of which are regularly used by local farmers, for their protection. Sprays of 2 lb. 50 per cent. wettable Sevin or DDT per 100 U.S. gal. or 0·5 lb. rotenone per acre in a 1 per cent. dust were applied weekly from 14th August to 23rd December, and observations at 10-day intervals from 16th September showed that Sevin gave very effective control of the first four species and partial control of *Agromyza*, which was apparently unaffected by DDT or rotenone; there were no phytotoxic effects. Sevin and DDT increased the yield by 441 and 242 per cent., respectively, whereas rotenone did not affect it, and plants treated with Sevin produced ripe fruits more rapidly than others.

Blinn (R. C.), Gunther (F. A.) & Mulla (M. S.). **Infrared determination of aldrin and dieldrin in aldrin-treated soil.**—*J. econ. Ent.* **53** no. 6 pp. 1129–1131, 2 figs., 8 refs. Menasha, Wis., 1960.

The authors give details of an infra-red evaluation designed to separate, identify and determine the amounts of aldrin and dieldrin (to which aldrin is converted) in soils that have been treated with aldrin. The procedures permit over-all recovery of 92 and 75 per cent. of aldrin and dieldrin, respectively, and respond reliably to 50 μg. aldrin and 80 μg. dieldrin.

Fribourg (H. A.) & Stanley (W. W.). **The effect of heptachlor and toxaphene on stand of ladino clover.**—*J. econ. Ent.* **53** no. 6 pp. 1134–1135, 1 fig. Menasha, Wis., 1960.

In tests in Tennessee of the effect of soil insecticides on the stand and length of life of forage plants, heptachlor was applied at 3 lb. per acre in 2·5 per cent. granules to an established sod of tall fescue [*Festuca elatior*] and ladino clover [*Trifolium repens latum*] in May 1956, and comparison with untreated plots at three cuttings in 1956 and seven in 1957 showed no significant effect on forage yield or botanical composition.

In April 1958, the treated plots were treated with 1·5 U.S. pints 25 per cent. demeton, 50 lb. granules containing 2·5 per cent. Di-Syston [O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate], 2 lb. toxaphene in a spray

or 3 lb. heptachlor in 10 per cent. granules per acre, and the untreated ones received the first three treatments or none; the demeton treatment was repeated five times at monthly intervals from April 1959, the Di-Syston treatment in April and June 1959 and the toxaphene treatment at ten-day intervals, twice in April 1958 and 14 times from 6th April 1959, and the plots were cut five times in 1958 and eight times in 1959. There were no significant differences in forage production, and the stands of fescue were unaffected, whereas the clover stands increased from 50 to 75 per cent. of the whole in plots treated with heptachlor but had decreased slightly in others by October 1958. In 1959, plots treated with heptachlor in 1958 continued to show a better clover stand than others, and those treated with toxaphene showed a marked improvement, whether they had been treated before or not. It is not known whether the improvement in clover stand was due to reductions in insect population, stimulation of clover growth or depression of fescue growth.

Bowling (C. C.). **A comparison of the effectiveness of aldrin seed treatment for rice water weevil control on water- and drill-seeded rice.**—*J. econ. Ent.* **53** no. 6 pp. 1135–1137, 1 fig., 2 refs. Menasha, Wis., 1960.

About 20 per cent. of the rice grown in Texas is sown by dropping pre-sprouted seeds into flooded fields by aeroplane; sacks of seeds are submerged in canals for 24 hours for sprouting, and the seed is sown after another 24 hours of germination. Tests were made in 1959 to determine whether aldrin, applied at 4 or 8 oz. per 100 lb. seed in a slurry made from a 50 per cent. wettable powder [*cf. R.A.E.*, A **48** 476], would be retained through these processes in quantities sufficient to give control of *Lissorhoptrus oryzophilus* Kuschel. Comparison of plants from treated seed sown in drills on 17th June and in water on 18th July showed no significant differences in insect control between rates of application or between methods of sowing, all treatments causing significant reductions in infestation. Yields were significantly higher from treated than from untreated and from water-sown than from drill-sown seed. In water-sowing, treated seeds sank to the soil surface more readily than untreated ones, probably owing to the wetting agent in the wettable powder, and this might be of benefit on windy days.

Rogers (W. I.) & Hilchey (J. D.). **Studies on the postirradiation feeding activity of** *Tribolium castaneum* **(Tenebrionidae: Coleoptera).**—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 584–590, 2 graphs, 21 refs. College Park, Md., 1960.

The following is virtually the authors' abstract. Adults of *Tribolium castaneum* (Hbst.) that had been exposed to selected doses of high-speed electrons from a Van de Graaff electrostatic generator [*cf. R.A.E.*, A **44** 272] were subsequently offered various diets. Observations on survival period and radioisotopic studies with ^{32}P showed that they fed to some degree after irradiation. After exposure to lethal doses of 27,400 rads or more, feeding ceased for at least two days. It was resumed between the second and seventh day and continued thereafter until death; the amount of feeding depended on the dose of radiation previously applied. The nutritional state of the beetles after exposure to certain doses affected their life expectancy. At least two dose-dependent modes of mortality response were exhibited, and starvation was not a primary cause of death in irradiated individuals.

King (E. W.) & Riley (R. C.). **Effect of light on the temperature preferendum of larvae of the Mexican bean beetle,** *Epilachna varivestis*.—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 591–595, 5 graphs, 5 refs. College Park, Md., 1960.

The following is virtually the authors' abstract. Second-instar larvae of *Epilachna varivestis* Muls. were allowed to find their preferred temperature on a circular thermal-gradient disk, under conditions of 40-foot-candle and of 1-foot-candle illumination. Tests in dim light were made with 1,633 insects and in bright light with 1,052, and each individual was used once only. In dim light, the preferred temperature was between 70 and 75°F.; in bright light, the preference was less pronounced, and was between 90 and 100°F. Differences in pretreatment or in the evaporation rate during tests (the only other experimental variables) appeared to have no bearing on the shift of temperature preference, and a statistical test indicated little likelihood of correctly attributing the observed results to a sampling error. Two possible conclusions are suggested: the temperature preferendum for this insect in this stage may be altered by light conditions and therefore is not completely related to, or identical with, the temperature optimum, or the temperature optimum may be changed with changing light.

Ludwig (D.) & Fiore (C.). **Further studies on the relationship between parental age and the life cycle of the mealworm,** *Tenebrio molitor*.—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 595–600, 1 graph, 7 refs. College Park, Md., 1960.

The following is based on the authors' abstract. Eggs of *Tenebrio molitor* L. were collected at intervals of two weeks throughout the egg-laying period of beetles maintained at 30, 25 and 20°C. [86, 77 and 68°F.]. Eggs and larvae were maintained at the same temperature as was used for the parent beetles. Parental age had no effect on the duration of the egg stage or on the weights of the eggs or newly hatched larvae. At each temperature, the percentage of eggs that hatched decreased with an increase in parental age, from approximately 90 for those laid during the first two months to about 50 for those laid four months after emergence. At each temperature, larvae from young parents grew at a slower rate than those from the same parents after they had aged nine weeks. At 30°C., there were no other effects of parental age, but, at 25 and 20°C., larvae from young parents required a significantly longer time to complete development and underwent more moults than those from the same parents after they had aged one month or longer. At these temperatures, an increase in parental age resulted in a decrease in the duration of adult life. This effect was not evident until the parents had aged nine weeks in a series in which water was added to the food after six weeks of larval life, and six weeks in one at 25°C. in which water was added to the food throughout the larval period. In every case larvae from the second series grew at a faster rate and required less time for development than those of the first.

Gupta (P. D.) & Sinha (R. N.). **Excretion and its products in some stored-grain-infesting beetles.**—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 632–638, 13 figs., 20 refs. College Park, Md., 1960.

The following is virtually the authors' abstract. Urine is excreted as a clear fluid through the malpighian tubules in adults of *Tribolium confusum*

Duv., *Cryptolestes ferrugineus* (Steph.), *C. turcicus* (Grouv.), and *Sitophilus granarius* (L.). A portion of the uric acid and urates remains stored in the fat-body of *S. granarius* only. Heavy deposits of storage excretion (not uric acid or urates) in the form of dark brown granules are present in the cells of malpighian tubules of *T. confusum*, *C. ferrugineus* and *C. turcicus*, but no such deposit occurs in *S. granarius*. Uric acid and urates enter through the wall of the anterior portion of the hindgut in *S. granarius*, whereas in the other three species the urine discharged through the malpighian tubules contains a solution of uric acid and its salts. Presence of a large quantity of uric acid seems responsible for lowering the hydrogen-ion concentration in the hindgut of all the four species.

Pond (D. D.). **Life history studies of the armyworm, *Pseudaletia unipuncta* (Lepidoptera: Noctuidae), in New Brunswick.**—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 661–665, 1 fig., 2 refs. College Park, Md., 1960. **Errata.**—*Op. cit.* **54** no. 2 p. 168, 1961.

The following is virtually the author's abstract. The life-history of *Pseudaletia unipuncta* (Haw.) in New Brunswick is described. In laboratory tests, females were found capable of laying more than 1,400 eggs. When the two sexes were reared at the same temperatures, there were no significant differences between them in the number of larval moults or in the duration of the various stadia. However, under partial starvation conditions, 86 per cent. of the females moulted seven times rather than six, as compared with 33 per cent. of the males. Seven moults occurred also in both sexes when larvae were reared in a temperature range minimal for their development, and the head-capsule width of such seventh-instar larvae was less than that of sixth-instar larvae reared at higher temperatures. Less than 1 per cent. of the armyworms reared at Fredericton from 1953 to 1958 were parasitised, but 14 Hymenopterous and 11 Dipterous species were reared from them.

Shorey (H. H.) & Gyrisco (G. G.). **Effects of soil temperature and moisture on the vertical distribution of European chafer larvae.**—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 666–670, 4 graphs, 10 refs. College Park, Md., 1960.

The following is virtually the authors' abstract of this account of field and laboratory investigations in New York on the way in which soil temperature and moisture affect the vertical distribution of the larvae of *Amphimallon majalis* (Razoum.). In the field, larvae moved down in the soil as it dried, though no pronounced change in their vertical distribution was observed until after the drying had proceeded below the range of available soil moisture. In laboratory studies, first- and second-instar larvae responded to a small moisture difference between two adjoining very dry soils, but did not respond to a similar slight moisture difference between two wetter soils. Overwintering second-instar larvae migrated downward earlier in the autumn, arrived at a greater winter depth, and moved back toward the surface later in the spring than did third-instar larvae. In the laboratory, second-instar larvae responded to an artificially created temperature gradient by moving in largest numbers to soils having temperatures between 17 and 27°C. [62·6 and 80·6°F.].

Clark (E. W.) & Chadbourne (D. S.). **The haemocytes of nondiapause and diapause larvae and pupae of the pink bollworm.**—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 682–685, 1 graph, 23 refs. College Park, Md., 1960.

The following is the authors' abstract. Total counts of the haemocytes of non-diapause and diapause larvae and pupae of the pink bollworm (*Pectinophora gossypiella* (Saund.)) showed no significant differences between the three groups—averaging 18,962 cells/cu. mm. in the fourth-instar larvae and 22,174 in the pupae. The differential counts showed no differences between the sexes within each of the three groups, but distinct differences between the stages—the proleucocytoids and plasmatocytes being lower and the spheroidocytes and cystocytes higher in the diapause larvae. No podocytes or vermiform cells were found.

Ridgway (R. L.) & Gyrisco (G. G.). **Effect of temperature on the rate of development of** *Lygus lineolaris* **(Hemiptera: Miridae).**—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 691–694, 2 figs., 3 refs. College Park, Md., 1960.

The following is virtually the authors' abstract. *Lygus lineolaris* (P. de B.) was reared in the laboratory with green pods of the common bean, *Phaseolus vulgaris*, as a source of food. The egg stage averaged 42·08, 14·66, 7·62, 6·65 and 6·04 days at constant temperatures of 15, 20, 25, 30 and 35°C. [59, 68, 77, 86 and 95°F.], respectively. The rate of development of each instar was determined at 20. 25 and 30°C., at which temperatures the mean total lengths of all instars combined were 31·47, 19·68 and 14·91 days, respectively. First-instar nymphs failed to survive at 35°C. Preliminary investigations indicated a preoviposition period of seven days at 30°C., and slightly over eight days at 25°C. Some observations on the preoviposition period were also made at lower temperatures.

Howe (W. L.) & Gorz (H. J.). **Feeding preferences of the cowpea aphid among species of** *Melilotus*.—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 696–697, 3 refs. College Park, Md., 1960.

Aphis craccivora Koch (*medicaginis*, auct.) is considered in the United States to be mainly a pest of cowpea (*Vigna unguiculata* (*sinensis*)), but attacks many other plants. In June 1958, infestation developed on a caged plot containing numerous species and strains of *Melilotus* at Lincoln, Nebraska. There were wide differences in degree of attack, which are shown in a table, and they were not associated with the coumarin content or growth habit of the plants. In general, species of the subgenus *Micromelilotus*, which are annuals, were preferred to those of the subgenus *Eumelilotus*, which are almost all biennials.

Stevens (R. E.). **Biology and control of the pine needle-sheath miner,** *Zelleria haimbachi* **Busck (Lepidoptera; Hyponomeutidae).**—*Tech. Pap. Pacif. Sthwest For. Exp. Sta.* no. 30, [5 +] 20 pp., 7 figs., 14 refs. Berkeley, Cal., 1959.

The following is based on the author's summary. In the early summer of 1956, pine trees growing at an institute of forest genetics near Placerville, California, were severely infested by *Zelleria haimbachi* Busck. This

Hyponomeutid, all stages of which are described, attacks the needles of various species of *Pinus* and is widely distributed in Canada and the United States. The eggs are laid singly on the needles in midsummer, and the larvae mine the needles and overwinter in them during their first instar. In spring, they feed on the tender tissue within the sheaths of newly developing needle fascicles. The needles are severed within the sheath, and webbing is produced round the needle bases. The larvae require about ten fascicles each for development, and heavy infestation results in the destruction of almost all the needles on a tip. Pupation occurs in the tips in early summer, and the adults emerge about a fortnight later. Several parasites were reared from the larvae and pupae. A malathion emulsion spray applied in May 1957, when most of the larvae had left their overwintering sites and feeding on new growth was still negligible, gave excellent control.

HALL (R. C.). **Field tests of the resistance of hybrid pines to the pine reproduction weevil.**—*Tech. Pap. Pacif. Sthwest For. Exp. Sta.* no. 33, [6 +] 21 pp., 9 figs., 3 refs. [Berkeley, Cal.] 1959.

The following is substantially the author's abstract. The backcross hybrid of Jeffrey and Coulter pines (*Pinus jeffreyi* × (*P. jeffreyi* × *P. coulteri*)) was tested in 1948–56 in three field plantings in California for resistance to the pine reproduction weevil, *Cylindrocopturus eatoni* Buch. [*cf. R.A.E.*, A **49** 538]. The standard of comparison was Jeffrey pine, which is highly susceptible to weevil damage. Two of the experimental plantings, at Mt. Shasta and Big Springs, were made in areas where damage had been severe in earlier brushfield plantings. The third, at McCloud Flat, was in an area where previous damage had been light.

The hybrid showed a marked resistance to weevil attack under field conditions, substantiating earlier findings in the nursery. Under equal exposure and chance of attack, seven times as many Jeffrey pines as hybrids were killed. Besides resistance to the weevil, the hybrid had slightly better planting survival and a somewhat higher growth rate than its Jeffrey-pine parent. These advantages indicate that it is a promising tree for use in future brushfield plantations in northern California, where damage from the weevil is frequently a limiting factor.

LYON (R. L.). **Tests with DDT foliar sprays to control the California flatheaded borer.**—*Res. Note Pacif. Sthwest For. Exp. Sta.* no. 152, 6 pp., 1 fig., 4 refs. Berkeley, Cal., 1959.

Tests in California showed that *Melanophila californica* Van Dyke attacking pine trees can be controlled by foliage sprays of DDT applied against the adults, but only at a rate considered excessive for forest use.

TERRELL (T. T.). **Sampling populations of overwintering spruce budworm in the northern Rocky Mountain region.**—*Res. Note Intermount. For. Exp. Sta.* no. 61, 8 pp., 2 figs., 3 refs. Ogden, Utah, 1959.

The following is based on the author's introduction and summary. It is sometimes desirable to know the size of the population of overwintering larvae of *Choristoneura fumiferana* (Clem.) in the northern Rocky Mountain

region of the United States. In the investigations described, this was done by cutting infested material from Douglas fir [*Pseudotsuga menziesii*] and forcing the larvae out of hibernation by transfer to a warm room. In a sampling design that provides adequate estimates of overwintering larvae, account must be taken of the facts that samples taken from north or south slopes yield higher populations than those from valley bottoms, that hibernating larvae are more numerous per unit of bark surface on trunks than on branches, and that five trunk sections are required from each sampling point for an adequate sample. It is noted that damage previously classified as light, moderate or heavy is not necessarily associated with subsequent proportionate hibernating populations and that infested material collected in late autumn and stored for a conditioning period may yield only about a quarter as many larvae as fresh material from the same site.

Berry (N. O.), Blanc (F. L.) & Klopfer (S. M.). **Pink bollworm detection in California.**—*Bull. Calif. Dep. Agric.* **48** no. 4 pp. 211–218, 5 figs., 1 map, 2 refs. Sacramento, Cal., 1959.

Details are given of the measures adopted to prevent the spread of *Pectinophora gossypiella* (Saund.) to cotton in California, where neither it nor *Anthonomus grandis* Boh. as yet occurs.

Walker (D. W.). **Population fluctuations and control of stored grain insects.**—*Tech. Bull. Wash. agric. Exp. Sta.* no. 31, [1+] 66 pp., 12 graphs, 50 refs. [Pullman, Wash.] 1960.

The following is based on the author's summary. Total storage capacity of the wheat-producing areas in Idaho, Oregon and Washington is about 350 million bushels. Much of the wheat grown in this area is for export markets. As a result, grain is often kept in storage in country elevators, on the farm or in terminal storage until market conditions are favourable. Insect infestation is usually not serious, but sometimes causes considerable loss. The common species found are *Tribolium castaneum* (Hbst.), *Oryzaephilus surinamensis* (L.) and *Cryptolestes* (*Laemophloeus*) *ferrugineus* (Steph.). Field infestations do not normally occur, so that the harvesting equipment is not an important source of contamination, and there was a wide variation in the number of insects present in empty bins prior to harvest, as determined by the method of release and recapture of insects labelled with ^{32}P. The effect of grain temperature and moisture on insect development was demonstrated in laboratory and field studies, and the relationship of the various species with the depth of the grain is discussed.

Sprays leaving a toxic residue reduced initial insect populations in empty bins, and were found to give some control during the storage season. Wettable-powder formulations gave better control than emulsion concentrates, and malathion and DDT proved the best insecticides under laboratory and bin conditions. Pyrethrins, cyclethrin and malathion were evaluated as protective treatments for direct application to the grain, and the first two were tested in field studies. Malathion was far more effective at low dosage than the others. Various commercial fumigants were evaluated as space fumigants, using adults of *T. castaneum* as the test insects, and dosage-mortality data are presented. At dosages recommended by the manufacturers, all proved effective.

PAPERS NOTICED BY TITLE ONLY.

KNOCHE (C.). **Einfluss der Luftfeuchtigkeit auf Larvenentwicklung und Eizahl verschiedener** *Dermestes*-**Arten.** [Effect of atmospheric humidity on the larval development and egg production of various species of *Dermestes*.]—*Mitt. hamburg. zool. Mus.* **58** pp. 1–46, 16 figs., 70 refs. Hamburg, 1960.

CRANHAM (J. E.). **The mite pests of tea** [in Ceylon and elsewhere]: **a review.**—*Tea Quart.* **31** pt. 1 pp. 5–11, 26 refs. Talawakele, 1960.

SMIT (B.), NOLTE (M. C. A.) & BRUNNEKREEFT (F.). **The fumigation of a railway grain elevator** [in South Africa with methyl bromide] **for the control of maize insects.**—*S. Afr. J. agric. Sci.* **2** no. 4 pp. 451–471, 3 figs., 1 ref. Pretoria, 1959. (With summaries in Afrikaans & French.) [*Cf. R.A.E.*, A **49** 57.]

MATHUR (R. N.) & BALWANT SINGH. **A list of insect pests of forest plants in India and the adjacent countries** (**arranged alphabetically according to the plant genera and species, for the use of forest officers**). **Part 4. List of insect pests of plant genera 'C' (concluded)** (*Clausena* **to** *Cytisus*).—*Indian For. Bull.* (N.S.) Ent. no. 171 (3), [1+] 45 pp. Delhi, 1960. **Part 5. List of insect pests of plant genera 'D' to 'F'** (*Dactyloctenium* **to** *Funtumia*).—*Op. cit.* no. 171 (4), [3+] 165 pp. 1959. **Part 6. List of insect pests of plant genera 'G' to 'K'** (*Gamblea* **to** *Kydia*).—*Op. cit.* no. 171 (5), 91 pp. 1960. [*Cf. R.A.E.*, A **48** 240, etc.]

MANICKAVASAGAR (P.). **Observations on the system of insect pest forecasting in Japan** [a review of methods for pests of rice].—*Trop. Agriculturist* **115** no. 1 pp. 15–27, 6 figs. [Colombo] 1959.

CAPCO (S. R.). **A list of plant pests** [mainly insects] **of the Philippines, with special reference to field crops, fruit trees and vegetables.**—*Philipp. J. Agric.* **22** (1957) no. 1–4 pp. 1–80, 9 pp. refs. Manila, 1959.

DRAKE (C. J.). **Insects of Micronesia. Vol. 7 no. 6. Hemiptera: Saldidae.**—pp. [3+] 287–305, 13 figs., 1 map. Honolulu, Bishop Mus., 1961. CARPENTER (F. M.). **Vol. 8 no. 3. Neuroptera: Hemerobiidae.**—pp. [3+] 35–43, 4 figs., 1 map. BEAL jr. (R. S.). **Vol. 16 no. 3. Coleoptera: Dermestidae.**—pp. [3+] 109–131, 5 figs., 1 map. [*Cf. R.A.E.*, A **43** 345; **49** 212.]

WOLFENBARGER (D. O.). **Insect pests of the avocado and their control** [in Florida].—*Bull. Fla agric. Exp. Sta.* no. 605, 51 pp., 35 figs. Gainesville, Fla., 1958.

WHITE (E. B.) & DEBACH (P.). **A wide-range variable temperature cabinet for bio-ecological studies.**—*J. econ. Ent.* **53** no. 6 pp. 1030–1034, 5 figs., 6 refs. Menasha, Wis., 1960.

JACKSON (C.). **A large cabinet with vestibule for rearing insects and other small animals, with controlled temperature, humidity and air distribution.**—*Canad. Ent.* **92** no. 7 pp. 522–528, 1 fig., 7 refs. Ottawa, 1960.

MORGAN (C. V. G.). **Anatomical characters distinguishing** *Bryobia arborea* **M. & A.** [*B. rubrioculus* (Scheuten)] **and** *B. practiosa* **Koch** (**Acarina: Tetranychidae**) **from various areas of the world.**—*Canad. Ent.* **92** no. 8 pp. 595–604, 5 figs., 7 refs. Ottawa, 1960.

CRAM (W. T.), ANDISON (H.) & THEAKER (T. L.). **A plastic leaf-cage for rearing insects on whole attached leaves.**—*Canad. Ent.* **92** no. 8 p. 640, 1 fig. Ottawa, 1960.

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